On the Development of Drainage Areas for the Water Supply of Cities and Towns.*

BY H. W. AYRES, OF HARTFORD.

When a town is to be supplied with water by gravity, one of the first problems to be determined, after the probable requirements of the town have been ascertained, is the yield or available quantity of water which may be depended upon from the drainage area included in the system.

Where but one reservoir, acting both as a storage and distributing reservoir, is required, and the conformation of the country is such that one of sufficient capacity can be built, is one of our most simple forms. We have in this case only to compute from the known area of water shed and the available percentage of rainfall the total yield of the drainage area, and having constructed our reservoir of sufficient size, provide a suitable and ample means of escape for any surplus. The capacity of such a reservoir, however, depends not on the average yield of its drainage area, but on the more or less intermittent flow of the streams passing away from it; and where the flow of these streams is at times less than the requirements of the town to be supplied, we must depend more or less on surface water, and our reservoir must have a sufficient capacity to furnish the required amount daily, without income, for a greater or less length of time, according to the more or less intermittent character of the springs and water-courses upon its shed; and where these are, as often happens, at times entirely dry, we must depend on surface water entirely, and the capacity of our reservoir should not be less than two-thirds the total yearly consumption of the town supplied. An examination of the character of the water-shed will, by comparison with others, the yield of which is known, enable us to fix the probable amount of rainfall upon which we may depend for storage, but I have seen no proportion which may be depended upon as to the probable monthly yield.

In some tables furnished by eminent engineers we shall find, for instance, that 25 per cent. of the mean monthly yield of the drainage area may usually be depended upon for the dryest month, and should we adopt this as a basis for calculation, we should in many cases find ourselves in serious error.

Many water-sheds, in reality furnishing a large yearly supply, yield nothing for some of the summer months. Statistics of rainfall can usually be procured in the vicinity of the proposed work, and calculations for storage and supply should be based on the record of the lowest years, except where all the available water is necessary, in which case our reservoir may be made of sufficient capacity to store the surplus from a wet year to tide over following less productive ones. This plan, however, is not to be adopted when it can well be avoided.

A thorough examination of all the surrounding country should always be made, even in what appear to be simple cases, as what at first appear to be a very simple form can often be greatly improved.

For instance, in the lay-out for the supply of a town with which I am familiar, it was found possible to construct a small reservoir lying in a valley with little or no drainage area, and by means of a large pipe connecting it with a considerable stream flowing at no time less than far beyond the requirements of the town to maintain the water in this reservoir at any desired height. The advantages of this plan are very numerous; not only is the safety of the work insured from any injury by surplus water in violent storms, but we are able to fill the reservoir from the best flow, as regards purity, of the stream entered, and also to maintain our reservoir at a uniform elevation, in which state it is less liable to become contaminated or to acquire a fishy or cucumber taste. Another case which often presents itself is where our drainage area is but little more than sufficient in size to meet our requirements, but does not offer an opportunity to combine a storage and distributing reservoir in one, or it is not wished to make such a combination, which is at best a most objectionable form for supply. The proper number, location and capacity of our reservoirs now become a most important matter, for if not properly arranged in these respects we may be unable to save the proper portion of the rain fall and perhaps come short of meeting the requirements of the town or city to be supplied. A study of the topography of the water shed will often enable us to make the proper portion directly by simply arranging the storage capacities of the different basins to be proportionate to the tributary drainage areas. Where this cannot be done, the natural subdivision of the shed may usually be so modified by the use of canals and ditches as to secure the proper proportion of drainage area to the best locations for storage.

Where no such proportionment can be secured, as close an approximation as possible must be made, when, if the discrepancy is not too great, a judicious regulation of the draft from these storage basins may compensate for their defective lay-out. In this or any case where more than one reservoir is to be built, one of the storage reservoirs should be as near as possible to the distributing reservoir, and when it can be so arranged, its waste water should pass outside of the drainage area on which it is built, in order to keep any surplus water out of the distributing reservoir, not only for the greater safety of the work, but because at times when water is wasting, it is less pure for an immediate use. Also this reservoir, acting as a settling basin, the water from it will enter the distributing reservoir, cleaner, and in better condition than that which comes directly from the adjoining drainage area. Furthermore, the arrangement of storage reservoirs should be such that each may be emptied at any time without interfering with the use of water from the others, and the distributing reservoir should also be so constructed that it may at any time be drawn entirely dry, without interfering with the use of water by the town supply, the object being to enable us at any time to clean our reservoirs and canals without inconvenience to the water takers.

All these canals and reservoirs act as settling ponds, and collect all the impurities which may exist in the water shed; and only by thorough and often repeated cleansing can our supply be maintained in its best quality. Where the amount of water required is large, and it is necessary to unite a number of separate drainage areas in order to secure a sufficient supply to meet the demands present and prospective, the problem becomes more complicated and affords room for considerable ingenuity.

The first essential to success is perfect familiarity with the topography of all the surrounding country and its natural divisions into drainage areas.

The first question is how to save all the water, and the second, to do so to the best advantage, not only as to the first cost of the works, but as to the convenience of their management and the expense of maintenance. All unnecessary canals and conduits should be dispensed with, not only on account of their cost, but the difficulty of preserving them in useable condition. It frequently happens, that a large storage reservoir can be built near or on the same drainage area as that feeding into our distributing basin, and that a proper location of other small reservoirs will enable us to throw all surplus water directly into this basin, without the use of artificial canals, leaving only the capacities for such reservoirs to be drawn on when required, and a pipe of moderate size extending into the next drainage area will, in such cases, perhaps form the best connection for the draft of such reserved water.

Where no such device can be resorted to, and it is necessary to store the water on its drainage area, open canals of large size form the best means of connecting the different systems, and the use of conduits or pipes should be avoided except when necessary to cross valleys. These canals should, if properly constructed and cared for, make little trouble. One of the principle difficulties to be guarded against in their construction is the liability to have them fill with snow and ice during the winter time, and thus become worthless for use at such times. In my experience I have been able to remedy this defect entirely by the use of movable dams or weirs, placed at intervals along the canal, thus holding it full of water, which, freezing over, prevents any further accumulation.

When it is desired to draw water through the canal, these dams are partly removed according to the amount of water way required, and replaced when the canal, as such, is no longer in use.

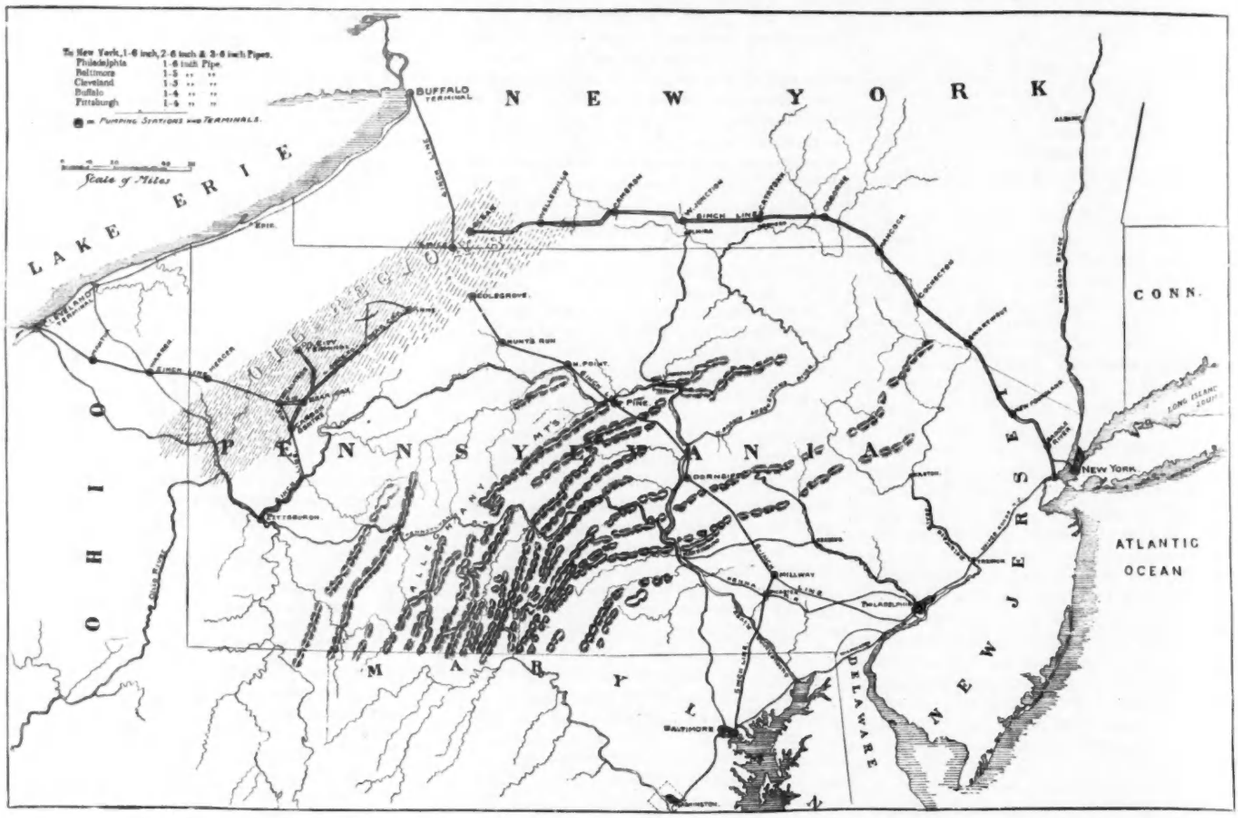
In long canals it is often necessary to provide waste ways in order to protect the banks from accumulating surface water in times of storm or melting snow. These waste ways should be located at points where the canal crosses small streams or water courses, at which places dams should be constructed and a pondage formed. These ponds helping to check the course of these currents, enable us to better regulate the grades of our canals and to utilize such incoming water with less canal area than would otherwise be possible. In this paper I have only indicated some of the methods of development which have come under my observation. Every case presents different features, which can only be properly met by the ingenuity and labor of the engineer who has charge of it, and I will add, that in the first layout for the supply of a town, the cost of the work is a secondary matter to which no material sacrifice of location or form of construction should be made, and any effort in this direction is labor thrown away, and money so saved is worse than wasted.

*Read at the Meeting of April 15th., of the Conn. Civil Engineers and Surveyors Association.

The Earliest Use of Gunpowder.

In a paper recently read before the Shanghai branch of the Royal Asiatic Society, Dr. Macgowan affirms the claims of the Chinese to be the originators of gunpowder and firearms. This claim was examined in an elaborate paper some years ago by the late Mr. Mayers, and decided by him in the negative. Dr. Macgowan admits that gunpowder, as now used, is a European discovery. Anterior to its granulation by Schwartz it was a crude compound, of little use in propelling missiles. This, says the writer, is the article first used in China. The incendiary materials stated by a Greek historian to have been employed by the Hindus against Alexander's army are stated to have been merely the naphthas or petroleum mixture of the ancient Boreans, and in early times used by the Chinese. The "stinkpot," so much used by Chinese pirates, is, it appears, a Cambodian invention. Dr. Macgowan states also that as early as the twelfth or thirteenth century the Chinese attempted submarine warfare, contriving rude torpedoes for that purpose. In the year 1000 an inventor exhibited to the then Emperor of China, "a fire gun and a fire bomb." He says that while the Chinese discovered the explosive nature of nitre, sulphur and charcoal in combination, they were laggards in its application, from inability to perfect its manufacture; so, in the use of firearms, failing to prosecute experiment, they are found behind in scientific gunnery.

MAP SHOWING THE NATIONAL TRANSIT CO'S PIPE LINES.



The National Transit Co.'s Pipe Lines, for the Transportation of Petroleum to the Seaboard.

Written for ENGINEERING NEWS.

While Englishmen and Americans have been alike interested in the late project for forcing water by a pipe line over the mountainous region lying between Suakim and Berber in the far-off Soudan, few men of either nation have any proper conception of the vast expenditure of capital, natural and engineering difficulties overcome and the bold and successful enterprise which has brought into existence far greater pipe lines in our own Atlantic States. We refer to the lines of the National Transit Company, which have for a purpose the economic transportation of crude petroleum from Western Pennsylvania to the sea-coast at New York, Philadelphia and Baltimore, and to the Lakes at Cleveland and Buffalo.

To properly commence our sketch of this truly gigantic enterprise, we must go back to the discovery of petroleum in the existing oil regions of Pennsylvania and adjacent States. Its presence as an oily scum on the surface of ponds and streams had long been known, and among the Indians this "rock-oil" was highly appreciated as a vehicle for mixing their wax-paint, and for annointing their bodies; in later years it was gathered in a rude way by soaking it up in blankets and sold at a high price for medicinal purposes only, under the name of Seneca Rock Oil, Genessee Oil, Indian Oil, etc.

But the date of its discovery as an important factor in the useful arts and as a source of enormous national wealth was about 1854. In the year named a certain Mr. George H. Bissell of New Orleans, accidentally met with a sample of the "Seneca Oil," and being convinced that it had a value far beyond that usually accorded it, associated himself with some friends and leased for 99 years some of the best oil springs near Titusville, Pa. This lease cost the company $5,000, although only a few years before a cow had been considered a full equivalent in value for the same land.

The original prospectors began operations by digging collecting ditches, and then pumping off the oil which gathered upon the surface of the water. But not long after this first crude attempt at oil-gathering, the Pennsylvania Rock Oil Co. was organized, with Prof. B. Silliman of Yale College as its President, and a more intelligent method was introduced into the developement of the oil-producing formation. In 1858, Col. Drake of New Haven was employed by the Pennsylvania Co. to sink an artesian well; and, after considerable preparatory work, on August 28, 1859, the first oil-vein was tapped at a depth of 69½ feet below the surface; the flow was at first 10 barrels per day, but in the following September this increased to 40 barrels daily.

The popular excitement and the fortunes made and lost in the years following the sinking of the initial well are a matter of history, with which we have here nothing to do. It is sufficient to say that a multitude of adventurers were drawn by the "oil-craze" into this late wilderness, and the sinking of wells extended with unprecedented rapidity over the region near Titusville and from there into more distant fields.

By June 1, 1862, 495 wells had been put down near Titusville, and the daily out-put of oil was nearly 6,000 barrels, selling at the wells at from $4.00 to $6.00 per barrel. But the tapping of this vast subterranean store-house of oleaginous wealth continued, until the estimated annual production was swelled from 82,000 barrels in 1859, to 24,385,966 barrels in 1883; in the latter year 2,949 wells were put down, many of them, however, being simply dry holes.* The total out-put of oil in the Pennsylvania regions, between 1859 and 1883, is estimated at about 243,800,000 barrels; enough oil to fill a tank about 10,000 feet square, nearly two miles to a side, to a depth of over 13½ feet.

As long as oil could be sold at the wells at from $4.00 to $10.00 a barrel, the cost of transportation was an item hardly worthy of consideration, and railroad companies multiplied and waged a bitter war with each other in their scramble after the traffic. But as the production increased with rapid strides, the market price of oil fell with a corresponding rapidity, until the quotations for 1884 show figures as low as 50 to 60 cents per barrel for the crude product at Oil City.

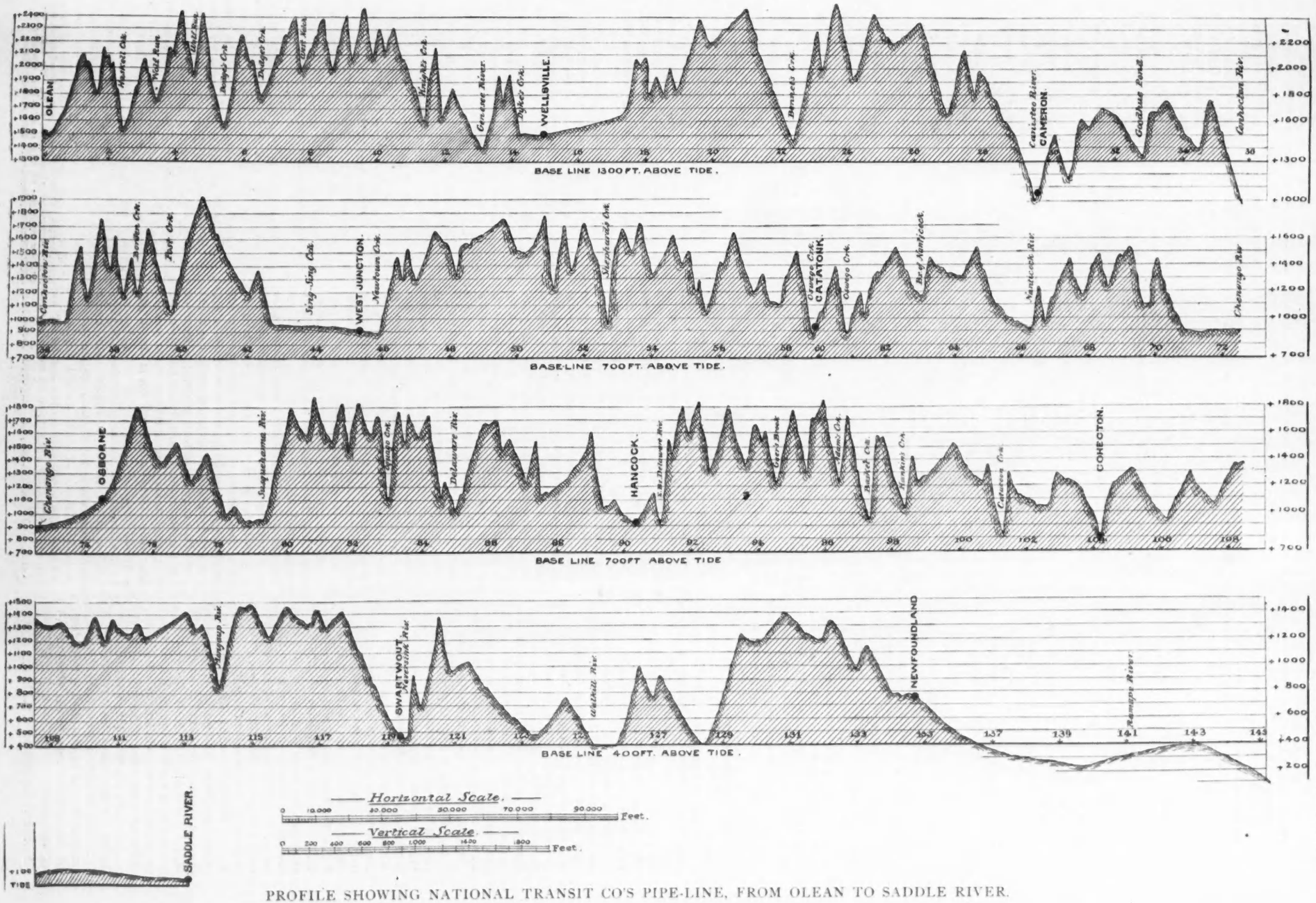
In December, 1865, the freight charge per barrel for a carload of oil from Titusville to New York, and the return of the empty barrels, was $3.50.* To this figure was added the cost of transportation by pipe-line from Pithole to Titusville, $1.00; cost of barreling, 25 cents; freight to Corry, Pa., 80 cents; making the total cost of a barrel of crude oil in New York, $5.55. In January, 1866, the barrel of oil in New York cost $10.40 including in this figure, however, the Government tax of $1.00 and the price of the barrel, $3.25.

The question of reducing these enormous transportation charges was first broached apparently in 1864, when a writer in the *North American*, of Philadelphia, outlined a scheme for laying a pipe-line down the Allegheny River to Pittsburg. This project was violently assailed by both the transportation companies, and the people of the oil region who feared that its success would interfere with their then great prosperity. But short pipe lines, connecting the wells with storage tanks, and shipping points, grew apace and prepared the way for the vast network of the present day which covers this region and throws out arms to the ocean and the lakes.

Among the very first, if not the first, pipe lines laid was one put down between the Sherman well and the railway terminus on the

* The total number of wells in the Pennsylvania Oil regions can not be given. In the years 1876–1884, inclusive, 28,619 wells were sunk; this is an average of 3,179 per year. During the same period 2,507 dry holes were drilled at an average cost of $1,500 each.

* It is stated that in 1862, the cost of sending one barrel of oil to New York was $7.45. Steamboats charged $2.00 per barrel from Oil City to Pittsburg, and the hauling from Oil Creek to Meadville cost $2.25 per barrel.



PROFILE SHOWING NATIONAL TRANSIT CO'S PIPE-LINE, FROM OLEAN TO SADDLE RIVER.

Miller Farm. It was about 3 miles long, and designed by a Mr. Hutchinson; he had an exaggerated idea of the pressure to be exercised, and at intervals of 50 to 100 feet he set up air chambers 10 inches in diameter. The weak point in this line, however, proved to be the joints; the pipes were of cast-iron and the joint leakage was so great that little, if any, oil ever reached the end of the line, and the scheme was abandoned in despair.

In connection with this question of oil transportation, a sketch of the various methods, other than pipe-lines, adopted in Pennsylvania may not be out of place. We are mainly indebted to Mr. S. F. Peckham in his article on "Petroleum and its Products" in the U. S. Census Report of 1880, for the information relating to tank-cars immediately following:

Originally the oil was carried in 40 and 42 gallon barrels, made of oak and hooped with iron; early in 1866, or possibly in 1865, tank-cars were introduced. These were at first ordinary flat-cars upon which were placed two wooden tanks, shaped like tubs, each holding about 2,000 gallons.

On the rivers, bulk barges were also, after a time, introduced on the Ohio and Allegheny; at first these were rude affairs and often of inadequate strength; but as now built they are 130 × 22 × 16 feet, in their general dimensions, and divided into eight compartments, with water-tight bulkheads; they hold about 2,200 barrels.

In 1871 iron-tank cars superseded those of wood, with tanks of varying sizes, ranging from 3,856 to 5,000 gallons each. These tanks were cylinders, 24 feet 6 inches long and 66 inches in diameter and weighed about 4,500 lbs. The heads are made of $\frac{5}{16}$ inch flange-iron, the bottom of $\frac{1}{4}$ inch, and the upper half of the shell of $\frac{5}{16}$ inch tank-iron.

In October, 1865, the Oil Transportation Co. completed and tested a pipe line 32,000 feet long; three pumps were used upon it, two at Pithole and one at Little Pithole. July 1st, 1876, the pipe-line owners held a meeting at Parkers to organize a pipe-line company to extend to the seaboard under the charter of the Pennsylvania Transportation Co., but the scheme was never carried out. In January, 1878, the Producers Union organized for a similar seaboard line, and laid pipes, but they never reached the sea, stopping their line at Tamanend, Pa. The lines of the National Transit Co., illustrated in our map, were completed in 1880-81, and this company, to which the United Pipe Lines have also been transferred, is said to have $15,000,000 invested in plant for the transport of oil to tide water.

The National Transit Company was organized under what was called the Pennsylvania Co. act, about four years ago, and succeeded to the properties of the American Transit Co., a corporation operating under the laws of Pennsylvania. Since its organization the first named company has constructed and now owns the following systems: The line from Olean, N. Y., to Bayonne, N. J., and to Brooklyn, N. Y., of which a full page profile is given showing the various pumping stations and the undulations over its route of about 300 miles. The Pennsylvania line, 280 miles long, from Colegrove, Pa., to Philadelphia. The Baltimore line, 70 miles long, from Millway, Pa., to Baltimore. The Cleveland line, 100 miles long, from Hilliards, Pa., to Cleveland, O. The Buffalo line, 70 miles long, from Four Mile, Cattaraugus Co., N. Y., to Buffalo, and the line from Carbon Centre, Butler Co., Pa., to Pittsburg 60 miles in length. This amounts to a total of 880 miles of main pipe-line alone, ranging from 4 inch to 6 inch in diameter; or, adding the duplicate pipes on the Olean New York line, we have a round total of 1,330 miles, not including loops and shorter branches and the immense net-work of the pipes in the oil regions proper.

A general description of the longest line will practically suffice for all, as they differ only in diameter of pipe used and power of the pumping plant. As shown on the map and profile this long line starts at Olean, near the southern boundary of New York State, and procedes by the route indicated to tide water at Bayonne, N. J., and by a branch under the North and East Rivers and across the upper end of New York City to the Long Island refineries. This last named pipe is of unusual strength and passes through Central Park; few of the thousands who daily frequent the latter spot being aware of the yellow stream of crude petroleum that is constantly flowing beneath their feet. The following table gives the various pumping stations on this Olean New York line, and some data relating to distances between stations and elevations overcome:

Pumping Stations.	Miles between Stations	Elevation above Tide. Ft.	Greatest Summit between stations Ft.
Olean		1490	
Wellesville	28.20	1510	2490
Cameron	27.91	1042	2530
West Junction	29.70	911	1917
Catatonk	27.37	869	1768
Osborne	27.99	1092	1539
Hancock	29.86	922	1873
Cohecton	26.22	748	1854
Swartwout	28.94	475	1478
Newfoundland	29.00	768	1405
Saddle River	28.77	35	398

On this line two six-inch pipes are laid the entire length, and a third six-inch pipe runs between Wellsville and Cameron, and about half way between each of the other stations, "looped" around them. The pipe used for the transportation of oil is especially manufactured to withstand the great strain to which it will be subjected, the most of it being made by the Chester Pipe and Tube Works, of Chester, Pa., the Allison Manufacturing Co., of Philadelphia and the Penna. Tube Works, of Pittsburg, Pa. It is a lap-welded, wrought-iron pipe of superior material and made with exceeding care and thoroughly tested at the works. The pipe is made in lengths of 18 feet and these pieces are connected by threaded ends and extra strong sleeves. The pipe-thread and sleeves used on the ordinary steam and water pipe are not strong enough for the duty demanded of the oil-pipe. The socket for a 4-inch steam or water pipe is from $2\frac{1}{2}$ to $2\frac{3}{4}$ inches long and is tapped with 8 standard threads to the inch, straight or parallel to the axis of the pipe; with this straight tap only three or four threads come in contact with the socket threads or in any way assist in holding the pipes together. In the oil-pipe, the pipe ends and sockets are cut on a taper of $\frac{3}{4}$ inches to one foot, for a 4-inch pipe, and the socket used is thicker than the steam and water socket, is $3\frac{3}{4}$ inches long and has entrance for $1\frac{5}{8}$ inches of thread on each pipe end tapped with 9 standard threads to the inch. In this taper socket you have iron to iron the whole length of the thread, and the joint is perfect and equal by test to the full strength of the pipe. Up to 1877 the largest pipe used on the oil lines was 4-inch, with the usual steam thread, but the joints leaked under the pressure, 1,200 pounds to the square inch being the maximum the 8-thread pipe would stand. This trouble has been remedied by the 9-thread, taper-cut pipe of the present day, which is tested at the mill to 1,500 pounds pressure, while the average duty required is 1,200 pounds; as the iron used in the manufacture of this line-pipe will average a tensile test strain of 55,000 pounds per square inch, the safety factor is thus about one-sixth.

The line-pipe is laid between the stations in the ordinary manner, excepting that great care is exercised in perfecting the joints. No expansion joints or other special appliances of like nature are used on the line as far as we can learn; the variations in temperature being compensated for, in exposed locations by laying the pipe in long horizontal curves. The usual depth below the surface is about 3 feet, though in some portions of the route the pipe lies for miles exposed directly upon the surface. As the oil pumped is crude oil, and this, as it comes from the wells carries with it a considerable proportion of brine, freezing in the pipes is not to be apprehended. The oil, however, does thicken in very cold weather, and the temperature has a considerable influence on the delivery.

A very ingenious patented device is used for cleaning out the pipes, and by it, the delivery is said to have been increased in certain localities 50%. This is a stem about $2\frac{1}{2}$ feet long, having at its front end a diaphragm made of wings which can fold on each other, and thus enable it to pass an obstruction it cannot remove; this machine carries a set of steel scrapers, somewhat like those used in cleaning boilers. The device is put into the pipe and propelled by the pressure transmitted from the pumps from one station to another; relays of men follow the scraper by the noise it makes as it goes through the pipe, one party taking up the pursuit as the other is exhausted. They must never let it get out of their hearing, for if it stops unnoticed, its location can only again be established by cutting the pipe.

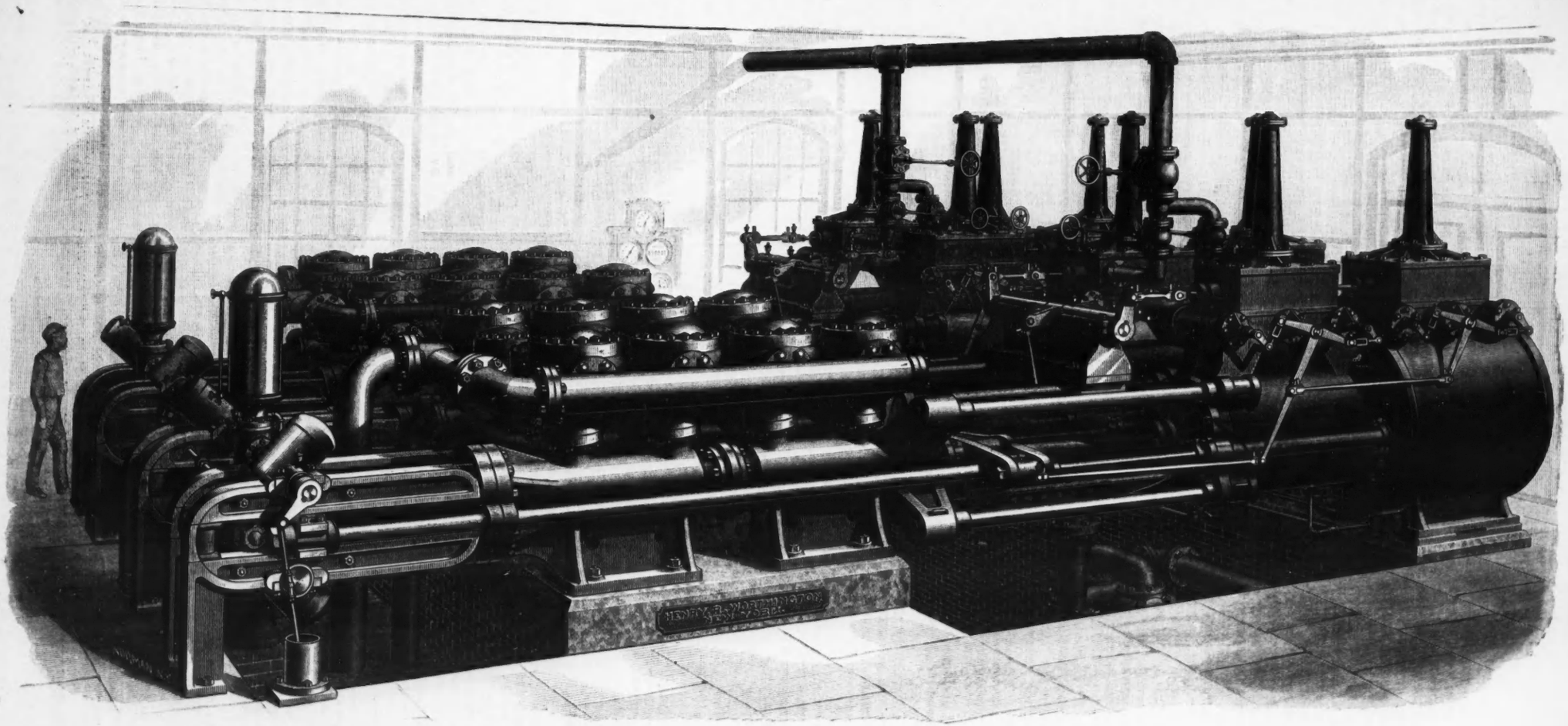
The pumping stations are substantial structures of brick, roofed with iron. The boiler house is removed some distance from the engine house for greater safety from fire; the building, about 40 by 50 feet, contains from six to seven tubular boilers, each 5 by 14 feet, and containing 80 three-inch tubes. The pump-house is a similar brick structure about 40 by 60 feet, and contains the battery of pumping engines to be described later. At each station are two iron tanks, 90 feet in diameter and 30 feet high; into these tanks the oil is delivered from the preceding station, and from them the oil is pumped into the tanks at the next station beyond. The pipe-system at each station is simple, and by means of the "loop-lines" before mentioned the oil can be pumped directly around any station if occasion would require it.

The pumps used on all these lines are the Worthington compound, condensing, pressure pumping engines. The general characteristics of these pumps are, independent plungers with exterior packing; valve-boxes subdivided into separate small chambers capable of resisting very heavy strains, and leather-faced metallic valves with low lift and large surfaces. These engines vary in power from 200 to 800 horse-power, according to duty required. They are in continuous use, day and night, and are required to deliver about 15,000 barrels of crude oil per 24 hours, under a pressure equivalent to an elevation of 3,500 feet.

We illustrate herewith the latest pumping engine plant, and the largest yet built for this service, by the firm of H. R. Worthington; it is to be used at the Osborne Hollow Pumping Station. As patents are yet pending on certain new features in this engine, we must defer a full description of it, for a later issue of our journal.

The Pennsylvania line has a single 6-inch pipe 280 miles long, with six pumping stations; as shown in the map, and groups of shorter lines, with a loop extending from the main line to Milton, Pa., a shipping point for loading on cars. *At Millway, Pa., a 5-inch pipe leaves the Pennsylvania line and runs to Baltimore, a distance of 70 miles, and is operated from the first named station alone, there being no intermediate pumping station.* The Cleveland pipe, 100 miles long, is 5 inches in diameter, and has upon it four pumping stations; it carries oil to the very extensive refineries of

* Millway is about 400 feet above tide-water at Baltimore, but the line passes over a very undulating country in its passage to the last named point. We regret that we have no profile on this 70-mile line operated by a single pumping plant.—ED. ENGINEERING NEWS.



The Worthington Compound, Condensing, Pumping Engines; with High-duty Attachment.

BUILT FOR THE NATIONAL TRANSIT CO'S OIL PIPE LINES.

Capacity of each Engine : 25,000 Barrels of Oil in 24 Hours ; against a pressure of 1500 pounds per square inch.

the company at the terminal on Lake Erie. The Buffalo line is 4 inches in diameter and 70 miles long; it has a pumping station at Four-Mile and at Ashford (omitted on the map.) The Pittsburg line is 4 inches in diameter and 60 miles long; it has pumping stations at Carbon Center and at Freeport.

A very necessary and remarkably complete adjunct to the numerous pipe-lines of this company is an independent telegraph system extending to every point on its widely diverging lines. The storage capacity of the National Transit Co.'s system is placed at 1,500,000 barrels, and this tankage is being constantly increased to meet the demands of the producers.†

The company is officially organized as follows: C. A. Griscom, President; Benjamin Brewster, Vice President; John Bushnell, Secretary; Daniel O'Day, General Manager; J. H. Snow, General Superintendent. Mr. Snow was the practical constructor of the entire system, and the general perfection of the work is mainly due to his personal experience, energy and careful supervision. His engineering assistants were, Theodore M. Towe and C. J. Hepburn, on the New York line, and J. B. Barbour on the Pennsylvania lines.

The enterprise has been so far a great engineering success, and the oil delivery is stated on good authority to be within 2 per cent. of the theoretical capacity of the pipes. From a commercial standpoint, the ultimate future of the undertaking will be determined by the lasting qualities of wrought-iron pipe buried in the ground and subjected to enormous strain; time alone can determine this question.

In preparing this article we are indebted for information to the firm of H. R. Worthington, to General-Manager O'Day, of the National Transit Co., to the editor of the *Derrick*, of Oil City, Pa., and to numerous engineering friends.

Roman and Gothic Masonry.

J. H. PARKER.

The Roman walls are often faced with brick or with ashlar in small cubes, sometimes on the exterior only, more frequently both inside and outside; but the strength of the walls does not in the least depend on the facing, and the interior is more commonly plastered only for the purpose of receiving mosaics or frescoes, or in ornamented with slabs of marble, or with stucco, or with bronze. In Rome itself and it a great part of Italy, the walls are almost entirely constructed of rubble or concrete, either of broken brick or rough stone, merely faced with cut stone or marble. In England and in Gaul the Roman walls are commonly built of rough stone with grouting, but banded together with layers of tiles at short intervals; and it is evident that the Romans depended more on their tiles or bricks for the strength of the wall than on the stone, and that the facing had nothing to do with the strength of the wall. In Mediæval walls this is reversed: the strength of the walls depends upon the ashlar, and, although the grouting often becomes a concrete mass, this was usually accidental. Double walls, with passages in them, could not stand if the ashlar was removed. In some cases, indeed, where the walls were very thick and had a passage in them, and the lime, being burnt on the spot, happened to be very good, the concrete mass remained as a rock long after the ashlar had been removed, as at Reading Abbey, but this was never the intention of the builders. The double walls of the Middle Ages were intended to form one whole, and appear to us almost a necessary part of the Gothic construction, although it is certain that the walls of Gothic buildings are not always so constructed. The interior is sometimes left rough and covered with plaster, and in country churches the exterior also, the walls being built of rubble only, but the double wall is clearly the more scientific construction.

† As showing the extent of the sea-coast transportation of petroleum, we would mention that the statistics for 1884, show a total of crude equivalent exported from the United States in that year, equalling 16,661,086 barrels of 51 gallons each. This is a daily average of 42,789 barrels.

Tall Chimney Construction[1].

[I].

As a return for some slight assistance we were able to give them in their investigations, the Messrs. Bancroft have sent us for re-publication the valuable paper on Chimney Construction which they last year read before the Civil and Mechanical Engineers' Society of London. We propose to re-publish it entire, and in that way secure for our readers a permanent record of their investigation:

It is of very great importance that the best materials and workmanship should be used in the construction of chimney-stacks, and that they should stand independent of all surrounding buildings, both on account of their greater weight, and on account of there being always a swaying motion in a gale of wind. It is also desirable that they should be built in the summer time, and the foundations should have time to settle before erecting the shaft, for great pressure will prevent the setting of any concrete that may be used in the foundations. It is imperative that these rules should be observed, so as to ensure stability, and render less liable the failures and fatal occurrences that are so often recorded in our professional papers. Several instances will be mentioned during the progress of my paper, and I may state that Mr. Edwin Nash, in his paper on "Failures in Construction," mentions that in 1849, soon after being erected, the chimney at the Counterslip Sugar Works, Bristol, fell, and several years ago there was another case at Joynson's Paper-Works, St. Mary Cray, and at many other places, and generally from careless design or bad workmanship, both of which are quite inadmissible in tall structures.

I find upon reference to the various authorities who have written about chimney construction, that there is a wide difference of opinion as to the proper dimensions they should have.

Mr. Robert Armstrong, in the appendix to his "*Chimneys, Furnaces, and Fireplaces*," published by Spon (1866), page 63, says: "It may be set down as an axiom that a *steam-engine chimney cannot be too large*, if only provided with a damper, although ninety-nine in one hundred at the present time (1866) are decidedly too small. They are unable to create a sufficient draught of air through the furnace, consequently a *smoky flame* is produced, instead of a flame with little or no smoke."

Against Mr. Armstrong's opinion we learn from Mr. Peter Carmichael, in his paper on "Factory Chimneys," read before the Institution of Engineers in Scotland, 1865, that his "experience is that most factory chimneys are too large for the work they have to do; not too high (they can hardly be that), but too wide, especially at the top. In our practice (Messrs. Baxter Brothers' flax mills, Dundee), invariably as more boilers and furnaces have been added to a chimney the draught has been improved; and it is obvious, that if the opening in the chimney be too large compared with the whole of openings in the dampers passing into it, the draught will be reduced. Hence it is very noticeable in many chimneys, which are too large in proportion to the number of furnaces they serve or the coals consumed, or when a new chimney is put up to serve for prospective additional furnaces, that the smoke issuing from such has a very lazy ascent, and they are generally blackened a long way down from the top by the smoke, for when a breeze is blowing the smoke, instead of ascending, falls down the leeward side of the chimney, and clings to it like a ragged black flag."

Mr. Robert Wilson, in his "*boiler and factory chimneys*," published by Crosby, Lockwood & Co., 1877, cautions us against too large a flue; he says: "It is usually considered that the larger the area of the chimney the better the draught, but this is not always the case with lofty chimneys where the gases can *cool down too rapidly* in a chimney of large section, and it has been found in several instances that when chimneys are very large for the number of boilers they serve, or for the quantity of coals burnt, as when a chimney is built to serve for future additions to the boiler power, the draught is improved by the better maintenance of temperature as additional boilers are set to work [thus agreeing almost word for word with Mr. Peter Carmichael] When the area of the chimney is much larger than the aggregate area of the flues debouching upon it, the diminution of friction and the expansion of the hot gases into a large area, are favorable for the improvement of the draught. But the velocity of the ascent of the heated gases may be very much diminished, and in extreme cases, where the ascending current does not fill the chimney, so to speak, downward currents of air will be produced, especially with the wind in certain directions, to the impairment of the draught."

TEMPERATURE OF ESCAPING GASES.

Mr. Peter Carmichael recorded observations made from time to time for several years on the temperature of the escaping products of combustion in the flues, and at the bottom of the chimneys, and also took notes of the force of the draught, both of which are important elements in considering the value of a chimney for doing its work properly, and he gives the results as follows:

The temperature is obtained by using small strips of the following metals: zinc, which melts at 700°; lead, 600°; bismuth, 500°; and tin 440°. Small bits of each of these, about one inch long and one-half inch broad, are pierced with a hole for passing a wire through, and suspended in the flues behind the damper, or at the bottom of the chimney, and the time noted when they are melted. From these observations, frequently repeated and tried under various circumstances, it has been found that the temperature is nearly uniform at 600° behind the dampers; 440° melts at once, 500° generally in less than a minute; 600° melts when the fires are in good condition; and 700° does not melt. So unvarying are these results under different circumstances, that I assume 600° at the bottom of our chimneys as a standard of temperature of escaping products.

FOUNDATIONS.

The foundation of a structure bearing a great weight upon a small surface must be carefully attended to. If a good natural bottom is not to be obtained, an artificial foundation must be made, either by concreting or driving piles; the former is generally sufficient. At the spot upon which the structure is to be raised, the different strata immediately beneath the surface must be examined by boring until some definite stratum be reached; by a reference to the depth of this bed some idea of the extent of excavation is arrived at. In all cases the foundation must be equally resistant; that is, all parts of it must be capable of bearing the same amount of pressure; if this be not attended to, unequal settlement is sure to result. In all cases the "made earth" must be removed. If the stratum immediately beneath be of clay, gravel, chalk, or other firm bed, and found to be sufficiently thick for a solid bearing, the excavation may be finished and the foundation laid in. In the neighborhood of London, the sub-stratum is generally "made earth," beneath which, at variable depths, not often exceeding twelve feet, a good bottom is usually met with, when, to save brickwork, concrete may be thrown in until only enough depth is left from the surface to cover the footings of the chimney.

The building for the Albion Mills was erected upon a very soft soil, consisting of the "made ground" at the abutment of Black-

[1] A paper by R. M. Bancroft and F. J. Bancroft, read before the Civil and Mechanical Engineers' Society. Reprinted from *American Architect*.

friars Bridge. To avoid the danger of settlement in the walls, or the necessity of going to a very unusual depth with the foundation, Mr. Rennie adopted the plan of forming inverted arches upon the ground, over the whole space upon which the building was to stand, and for the bottom of the dock. For this purpose the ground upon which all the several walls were to be erected was rendered as solid as is usual for building, by driving piles where necessary and then several courses of large, flat stones were laid to form the foundations of the several walls; but to prevent any chance of these foundations being pressed down, in case of the soft earth yielding to the incumbent weight, strong inverted arches were built upon the ground between the foundation courses of all the walls, so as to cover the whole surface included between the walls; and the abutments or springings of the inverted arches being built solid into the lower courses of the foundations, they could not sink unless all the ground beneath the arches had yielded to compression, as well as the ground immediately beneath the foundation of the walls. By this method the foundations of all the walls were joined together so as to form one immense base, which would have been very capable of bearing the required weight, even if the ground had been of the consistence of mud; for the whole building would have floated upon it as a ship floats in water; and whatever sinking might have taken place would have affected the whole building equally so as to have avoided any partial depression or derangement of the walls; but the ground being made tolerably hard, in addition to this expedient of augmenting the bases by inverted arches, the building stands quite firm.

Mr. Edwin Nash, F. R. I. B. A., says it is possible to build well upon a uniform bed of peat by carefully spreading the weight over the whole surface, and many structures have been so built. Most of the houses in the neighborhood of Finsbury Square and Finsbury Circus stand upon a somewhat peaty bed, and the site of the London Literary Institution had a bed of that sort. If the whole of that building had been founded upon undisturbed surface of the peat, instead of cutting through it for the main external walls only, as was done, there would probably have been few or perhaps none of those irregular settlements which were occasioned by some subsidence of the internal walls, from the drying up of the peat a long time after the building had been erected, and which rendered underpinning necessary.

A good example of the value of concrete is afforded by a chimney that was built by Mr. Clegg, at Fulham, in 1829. The foundation was a quicksand. After the excavation was got out to the depth of fifteen feet, an iron rod sank, with little more than its own weight, fifteen feet more; it was, in fact, Mr. Clegg says, as bad a foundation as could possibly occur.

The pressure on foundation of the Edinburgh Gas Works Chimney is eight and one-half tons per square foot.

The piers of Charing Cross Railway bridge, resting on the London clay, bear a weight of six tons per square foot superficial, and show no sign of settlement.

TOWNSEND CHIMNEY, PORT DUNDAS.

The highest church spire in Europe that of St. Nicohlas, Hamburg, four hundred and seventy-two feet; that of Strasburg four hundred and sixty-six feet from ground surface. Both these heights exceed that of the "Townsend Chimney," Port Dundas, Glasgow; its total height from foundation to top of coping being four hundred and sixty-eight feet, and from ground level to summit four hundred fifty-four feet. The history of its construction, and of its threatened failure when nearly completed, will therefore be of great interest to all who have made chimney-shafts or stalks their study, and, indeed, to architects and engineers in general. The chimney was designed and built by Mr. Robert Corbett, Bellfield Terrace, Duke Street, Glasgow, for Mr. Joseph Townsend, Crawford-street Chemical Works, Port Dundas.

No piles were used in the foundation, which is built on "blue till," or clay, which is as solid and compact as rock. The foundation consists of thirty courses of bricks on edge, the lowest course being fifty feet, and the topmost course thirty-two feet diameter. This foundation was commenced on July 30, 1857, and finished on August 20 of the same year.

The erection of the shaft was continued until November 11, 1857, (excepting from September 3 to October 5, during which period operations were suspended). This closed the first season. The second season commenced on June 10, 1858, and closed on October 16 in the same year, the stalk at the latter date being two hundred and twenty-eight feet in height. The third and last season commenced on June 3, 1859, and the coping was laid on October 6 of the same year; but the work was suspended from September 15 to October 5, in consequence of the chimney swaying. During this interval it was restored by twelve cuttings with saws on the opposite side of the inclination, as detailed hereafter.

The inside lining or cone is of nine-inch firebrick, and about sixty feet in height, built distinct from the chimney proper, with air-space between, and covered on top, to prevent dust from falling in, but built with open work in the upper four courses, so as to allow of air passing into the chimney.

The size of the bricks used in the construction of this chimney was ten inches by four inches, by three and one-half inches, and the number consumed was as follows:

Common bricks in chimney	1,142,532
Composition and fire-bricks in cone	157,468
Total	1,300 000

The bricklayers' time was:

In 1857, 316	days of	10	hours each.
In 1858, 431½	"	"	"
In 1859, 423½	"	"	"

giving a total of 1,171 days' time occupied in building the chimney, which gives on an average 1,110 bricks built per day of ten hours by each bricklayer.

Besides the above number of bricks used in the chimney, there were also 100,000 used in constructing flues, etc. The total number of bricks laid in chimney and flues was 1,400,000, the weight of which, at five tons per thousand, is 7,000 tons.

The cope is of vitrified tile, purposely made about nine inches wide by three inches thick, flanged over wall of chimney, and jointed with Portland cement.

The top of the chimney was struck by lightning some time since, which displaced and threw to the ground some pieces of coping, and upon inspection only one of the flanges were found to be broken.

Iron hoops were built in at a distance from the surface of nine inches at the bottom, and four and one-half inches at the top, and at intervals of twenty-five feet in height.

The thickness of the wall of the chimney varies as follows, commencing, of course, at the ground level:

1st	section,	30	feet in	height,	5	feet	7 inches thick.
2d	"	30	"	"	5	"	2 " "
3d	"	30	"	"	4	"	10 " "
4th	"	40	"	"	4	"	5 " "
5th	"	40	"	"	4	"	0 " "
6th	"	40	"	"	3	"	7 " "
7th	"	40	"	"	3	"	2 " "
8th	"	40	"	"	2	"	9 " "
9th	"	40	"	"	2	"	4 " "
10th	"	52	"	"	1	"	11 " "
11th	"	52	"	"	1	"	7 " "
12th	"	20	"	"	1	"	2 " "
Total		454	feet from ground line.				

The height originally contemplated for the chimney was four hundred and fifty feet; but when about three hundred and fifty feet up it was proposed to add about thirty-five feet to the original height, making the total height four hundred and eighty-five feet; hence the increased height of the tenth and eleventh sections. But on the completion of the eleventh section this idea was abandoned, and therefore only twenty feet of the last thickness were added.

The building was not built by contract, but by day wages, as Mr. Townsend was not quite certain to what height he would carry it, or what deviation might be made in course of construction from the proposed plan. Three different dimensions were calculated by the builder; those carried out were the greatest of three. The builder calculates the cost of the chimney and cone (exclusive of iron hoops in chimney and flues) at from £5,500 to £6,000. Mr. Townsend estimates the cost of the whole, including flues, iron hoops, machinery and scaffolding at £8,000.

On September 9, 1859, the chimney was struck by a gale from the northeast, which caused it to sway; but the builder does not attribute the action to the gale alone, but to the pressure of the whole pile on the scaffolding, which was so constructed as not to yield to any pressure caused by a slight settling down.

The additional pressure thrown by the wind to the lee-side of stalk (the mortar of which was not solidified) was consequently too great for the scaffolding to bear, and caused the splice of one of the uprights to give way by abrasion, making the fibers of the wood to work in each other. The ends of the planks forming the scaffolding were placed about five feet or six feet apart vertically, and were tightly built into the masonry; but had a little space been left over each, the stalk would have subsided uniformly, and would possibly have withstood the gale. The builder observed the error, but too late. He thinks the deflection commenced at from one hundred feet to one hundred and fifty feet from the ground, so that the foundation and heaviest portion remained firm. Had not the process of sawing been commenced promptly and continued vigorously, in all liklihood the chimney would have followed. Even during the earlier part of the process of sawing, Mr. Townsend, who was on the ground the whole time, observed the deflection increasing, but as the sawing progressed he observed that the deflection got a check, and the chimney came-to gradually. The chimney was seven feet nine inches off the perpendicular, and seven feet less in height than before it swayed; but when brought back it gained its original height, at which time it was not completed by five feet.

Mr. Townsend made his observations during the sawing-back by taking a position in the room of the works near by the chimney where he had a full view of it, and fixing the ends of two pieces of twine to a beam above, he formed them into two plummet-lines in a line stalk, and with these alone he directed the adjustment of the colossal mass.

The sawing-back was performed by Mr. Townsend's own men, ten working in relays, four at a time sawing, and two pouring water on the saws. This work was done from the inside, on the original scaffolding, which of course had not been removed. Holes were first punched through the sides, to admit the saws, which were wrought alternately in each direction at the same joint. This was done at twelve different heights from the ground line, viz., 41 feet, 81 feet, 121 feet, 151 feet, 170 feet, 189 feet, 209 feet, 228 feet, 240 feet, 255 feet, 277 feet, and 326 feet. The men discovered when they were gaining by the saws being tightened with the superincumbent weight. It took six men continuously to do this work, at a cost of £400.

Prior to the sawing operations they had taken out and altered the bolts of the scaffolding, so as to relieve the pressure on it. This was done to meet the want of a little spare space over the ends of the uprights, as before stated.

PROTECTION FROM LIGHTNING.

In answer to inquiries I made, Mr. Townsend says: "Our stack is protected from lightning by two copper-wire conductors, half an inch thick, opposite each other all the way up, jointed to one pike fixed to the chimney, but standing above it, at the top. It was erected by a Steeple Jack, of Manchester, immediately after the chimney had been put straight, about 1859 or beginning of 1860. The chimney had been several time struck by lightning and slightly damaged. It is intended to put three more pikes at the top, and take the conductor round the chimney from pike to pike, to give a better opportunity for absorption of the electric fluid.

(TO BE CONTINUED.)

Engineering News

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, - - - New York City.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

PUBLISHED EVERY SATURDAY.

CONDUCTED BY

GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER M.Am.Soc.C.E.: M.Inst.C.E.

TERMS OF SUBSCRIPTION:

$4.00.....PER YEAR TO U. S. AND CANADA.
$5.56..... " " " FOREIGN COUNTRIES.

TABLE OF CONTENTS

	PAGE
On the Development of Drainage Areas for the Water Supply of Cities and Towns	369
The Earliest Use of Gunpowder	369
The National Transit Co's. Pipe Lines, for the Transportation of Petroleum to the Seaboard (*Illustrated*)	370
Roman and Gothic Masonry	374
Tall Chimney Construction	374
Editorial Notes	376
Report of the New York Department of Public Works, for Quarter Ending March, 31, 1885	376
The Stanhope Water Softener	376
The Water Supply of Paris since 1854	377
Metallic Railway Ties in Holland	377
Performance of Engines and cost per Mile Run	378
The Telehydro-barometer	378
Personals	378
American Society of Civil Engineers	379
Engineers Club of St. Louis	379
American Society of Mechanical Engineers	380
Track (*Illustrated*)	380
Correspondence	380
A Simple Process for Placing Concrete Under Water	381
Electric Tramcars	381
Literature	381
The History and Statistics of American Water-Works	381
Water	381
News of the Week	382
Contracting	383
Index to Periodicals	384
Market Report	384

Owing to the size of the cut of Pumping Engine furnished us through the courtesy of the firm of H. R. Worthington, we have been compelled to interfere somewhat with the "make-up" of page 373 of this issue. But as this engine is in itself a novelty, being here for the first time illustrated in any journal, and the cut is such a magnificent specimen of the engravers art, that we are willing to make some sacrifice for the sake of reproducing it in connection with our Pipe-line article.

The Broadway Surface Railway is practically finished. In about two weeks time a double track railway has been put down from Union Square to the Battery. Considering the troubles and delays incident to the incessent stream of wheeled vehicles circulating on what is probably the most travelled highway in America, this is pretty quick work.

THE war between the Penna. R. R. and the Balt. & Ohio R. R. for right of way through Philadelphia is now in the hands of the lawyers. John K. Cowan represented the Baltimore interests and the Hon. Wayne Mc Veagh those of the Penna. R. R., before the Railroad Committee of Councils last week.

Mr. Cowan described the route proposed by his Company and accused the Philadelphia authorities of granting rights to the 7-mile long Chestnut Hill Branch of the Penna. R. R. which it would now refuse to a corporation bringing 3000 miles of roads to their doors. He contrasted the liberal treatment of the Penna. R. R. in Baltimore with the stringent measures proposed in Philadelphia, and he claimed that the projected line was practically a combination of a tunneled or undergrade route with an elevated railway.

Mr. Mc Veagh, denied in a general way each of the assertions of his adversary; outlined the good work done by the Penna. R. R. for Philadelphia; claimed that the people had all the benefits of competing lines now in their shipments from the Penna. R. R.'s depots, and compared the statements of Mr. Cowan, as to comparative little harm to be apprehended from grade-crossings, with the stringent enactments of the City of Baltimore in permitting the Penna. R. R. to pass through that city. He said that the vital question was whether a railroad, whose main objective point was New York, should be allowed to pass through Philadelphia at grade. Further argument is to be heard after an inspection of the lines.

Report of the New York Department of Public Works, for Quarter Ending March 31, 1885.

The following matter is condensed from the official report of Commissioner Rollin M. Squire:

The total expenditure during the Quarter was $804,307.79; with $99,751.65 for 12 contracts entered into, and $469,465.19 for 22 contracts completed during the three months. The inspectors for the detection and suppression of water-waste visited 15,142 buildings and found 3,444 places where water was wasted in conquence of defective plumbing. During the quarter, 450 additional meters were set, making 12,075 now in use. The revenue from water during the quarter was, water-rents, $214,821.03; penalties, $3,045.55; permits to tap water pipes, $915.50; making a total of $218,782.08.

Commissioner Squire in a special communication says that the several appropriations for the different branches of his department are entirely inadequate to a proper and sufficient discharge of the duties thereof. In thirty-two out of thirty-nine appropriations, the esti mates were reduced by the Board of Estimates and Apportionment from 10 to 50 per cent. In the item of repair and renewal of pipe, stop-cocks, etc., the estimated expense was $300,000; the amount allowed was $175,000. With this latter amount, the department must provide for the maintenance and repairs of 563 miles of water-pipe, 5,960 stop-cocks and 7,400 hydrants,and also for the detection of water waste.

In this connection the Commissioner truly says that New York has now the maximum water supply attainable until the completion of the new aqueduct. The increase of popula tion and legitimate demand can only be met by reducing the per capita consumption. The average daily consumption of water in New York, since Jan. 1, is 80 gallons per head, rising in the extremes of cold and warm weather to 100 gallons. Assuming that at least five years will elapse before an additional supply can be brought in, and estimating the annual increase in population at 50,000, it will be necessary to reduce the daily consumption per capita during that period, to 76½ gallons in the first year; 63¾ gallons in the second year; 71½, in the third; 69 in the fourth, and 66⅞ gallons in the fifth year. This last is 34⅞ gallons more than is now used in Liverpool and 26⅝ gallons more than is consumed in our own city of Providence, R. I.

The measures for the suppression of water waste thus far put into operation are, the use of water meters for business consumption; the new method adopted in 1877 for supplying water for shipping and building purposes; the house inspection for detection of leaks in plumbing and wilfull waste; the night inspection of house-drains into sewers and the experimental application, on a small scale, of pressure gauges and other instruments to measure the flow and consumption of water in private dwellings.

About one-fifth of the entire water supply is now used in 11,000 business establishments, which have been metered; the other four-fifths is distributed to over 100,000 houses. The amount paid last year for water supplied through meters was nearly one-third of the entire water revenue. This shows that where meters are used the consumption is reduced about 35 per cent.; and with like restrictive measures or appliances to ascertain and control the use of water throughout the city, the entire consumption for the present population and business of the city could be reduced to about 70,000,000 gallons, or less than 55 gallons per head per day. The suppression of waste has already resulted in an increase of pressure in the lower parts of the city.

For the repairs and renewals of street pavement and regrading the present appropriation is $200,000, instead of the $300,000 asked for by the department. The length and area of pavements to be kept in repair from this appropriation is, granite and trap-block, 290⅝ miles, covering 5,800,000 square yards; cobble-stone. 37¾ miles, covering 655,000 square yards. Business interests of every kind, and the health, comfort and convenience of the public require that the pavements be kept in good condition. As a sanitary measure the maintenance of smooth and firm pavements is of equal importance with street cleaning and sewerage, because without it, accumulations of surface water and filth cannot be prevented. In the Final Estimate, the appropriation for labor and materials is reduced about one-third below the department estimate, and the appropriation for salaries of Inspectors nearly one-half. In regard to the latter, special protest against reduction is made, as the Department has recently organized a system of inspection of the work done in the streets by the gas companies, electric-light companies, telegraph companies, steam companies. railroad companies and all parties or corporations who receive privileges to use the public streets.

For repairing streets and avenues the appropriation is $358,000, while $500,000 was the department estimate. The 665,000 square yards of cobble pavement and about 1,000,000 square yards of the old style of square block pavement are totally unfit for the streets of this city, and until they are replaced by new and improved pavements, the full amount of $500,000 as limited by law, should be appropriated each year for this purpose. "Out of the $350,000 appropriated in the Final Estimate, $150,000 is set apart for repavement of Fifth Avenue, leaving only $200,000 for repavements in the rest of the city, which is utterly inadequate to meet the most urgent needs of repavement."

"As to the amount to be allowed for salaries for the supervision and inspection of this work the results of reducing it to $8,000 as proposed in the provisional estimate, would simply be that more than two-thirds of the work would have to be carried on without the presence of an Inspector to keep the contractors to a proper observance of the specifications.

With a total appropriation of $350,000 the allowance for salaries for supervision and inspection should not be less than $13,500."

The Stanhope Water Softener.

Engineering, for May 22nd, illustrates and describes an appliance for eliminating from water intended for manufacturing purposes, any objectional mineral matter it may contain.

The apparatus is the invention of Messrs. Gaillet and Huet, and is made in England at the Stanhope Works, Fulham, S. W. The system includes the speedy removal of the precipitates used to get rid of the sulphates of lime or magnesia in the water. These precipitates being comparatively light, it is difficult to separate them without an expensive apparatus; settling tanks are efficient, but slow in practice; and if filters are used the filtering material rapidly chokes and requires frequent cleaning.

The Stanhope device consists of a series o

rectangular wrought-iron towers, 9 × 15 feet by 28½ feet high. In the interior of these towers are a number of sloping shelves toothing into each other from opposite sides, but separated by varying distances; the shelves are riveted to alternate sides of the tower and do not reach quite across the tower.

The water with the chemical agents mixed with it enters at a low velocity at the bottom, and in rising must follow the devious path marked out by the shelves. The principle of action is that while the precipitates flow with the water they are somewhat heavier than this fluid and will not turn around the ends of the shelves with the same facility; they thus get carried into the still-water pockets at the bottom of the shelves, and are finally removed by proper blow-out pipes.

At the top of the tower are the tanks for the chemicals used; one of these tanks, 14 × 9 × 6 feet, holds the lime solution, the other, above the first, is 2 × 3 × 6 feet 8 inches, and contains the soda. The preparation of the reagents is as follows: A quantity of caustic soda is dissolved in the upper tank and kept there ready for use. In the large tank a quantity of slacked lime is placed every 12 hours, and stirred while the tank is run three-quarters full of water. The required amount of soda is then added, the quantity being measured by a float and a graduated scale, and then more water is admitted and the whole agitated for ten minutes. This mixture is drawn by a floating pipe from near the surface and decanted into a small tank provided with a ballcock that always keeps the surface at the same level. From this tank the fluid runs under a constant head into a pipe where it meets the water to be purified, and together they then pass to the base of the tower and rise through it as before described.

By preserving a constant head for both supplies the proportions of lime and soda always remain the same, and are easily adjusted. After treatment all that remains in the water are the sulphates of soda and the chloride of lime, neither of which give any trouble.

The Water Supply of Paris since 1854.

The *Annales des Ponts et Chaussées* for April, 1885, contains a historical sketch by M. Guillemain on the water supply of Paris, for the last 30 years, condensed as follows:

In 1854, the daily supply per inhabitant was 60 litres (15.6 gallons,) obtained from the Ourcy and the Seine; to which was added a feeble supply from Arcueil and the Grenelle artesian wells. The water was of poor quality, warm in summer, and muddy in winter. The fluid was scarce in the higher portions of the city, and reached few interiors of houses. At the present time the supply per capita per day is 220 litres (57.2 gallons); it is furnished to the highest floors of buildings and is limpid, pure and fresh.

This progress in 30 years is mainly due to the development of the plans suggested in 1854, by Belgrand, which may be summarized as follows:

The establishment of two separate systems of supply; water from a pure source for domestic use, and water from the river for public service, the industries, etc.

For the first named or domestic consumption, the author showed that it could be best obtained from the Dhuis and the Vanne, distant about 80 miles, lead into the city by aqueducts and siphon. When the water reached the city it was to be stored in immense distributing reservoirs of masonry, and covered to resist atmospheric influences; these reservoirs containing about 364,000 cubic metres or a three days supply. This scheme has been practically carried out with an increase in storage, etc., to meet the ever growing demand.

For the public and industrial service three pumping stations operated by hydraulic power, and eight stations operated by steam, pour into the six great special reservoirs each day from 350,000 to 400,000 cubic metres (94 to 106 million gallons) of water taken from the Seine and the Marne.

In total the entire distribution system equals in length 640 miles, and the delivery is made by 78,000 branches; of which 16,000 feed the innumerable street appliances and 62,000 supply the interior fixtures. The two systems are kept perfectly distinct.

For the regulation of private consumption, made necessary by the frightful waste of previous years, (the supply in July, 1881, being three times the unit of apportionment,) meters were introduced about 1878. Previous to this year the metered water was only 1½ per cent. of the total supply; now it is 65 per cent., and the meter is used in all houses where any industry is carried on requiring excessive use of water. Thanks to this meter service, it is now possible with a reduction of rates amounting to 2,500,000 francs per annum, to increase the receipts 1,500,000 francs; equivalent to an annual benefit of 4,900,000 francs.

The lowest present rates are 10 francs per annum, with the right to use 225 litres of pure water per day; for 60 francs, the daily supply is 500 litres (130 gallons.) The city permits the use of water in an apartment for three persons, for 16$^{3}/_{10}$ francs per annum; and for the entire house, for 32$^{1}/_{10}$ francs. The city puts in the water at its own expense. Water taken in quantity beyond that stated is paid for at the lowest price given.

For industrial uses, washing and sprinkling, an annual charge of 60 francs for one cubic metre of water per day is made; but this water is only furnished at points reached by the pressure from the normal level of the reservoirs devoted to this service.

Taking as an example the month of August, 1883, a season of the year when the demand is greatest, we find that Paris drew upon her reservoirs for 186 litres per inhabitant in each 24 hours. This quantity was reduced by leakage and waste to 172 litres, of which 74 were used on the streets and 98 for domestic consumption. Out of 80,000 buildings in Paris, 50,000 are now supplied with water and its supply is rapidly extending.

The pure water supply will need extension when all the houses named have a connection with the mains. M. Couche, Chief Engineer of the Water Department, has recently submitted to the municipal council a project for an additional water supply of 120,000 cubic metres at first, then 240,000 cubic metres some years later, and finally 370,000 in say twenty years. Two aqueducts each about 80 miles long, reaching to the east and west of Paris at an elevation sufficient for distribution, would bring in the waters of the Vigne, from near Verneuil, and the Voulzie, near Provins. These waters are fully equal to that of the Vanne and the Dhuis. Estimating for an aqueduct equal in carrying capacity to the maximum amount stated, the cost is put down at 65 million francs; this would bring the price of a cubic metre of water delivered in Paris, to between 4 and 4½ centimes. In this connection it is well to remember that the river water of the Marne, raised by the hydraulic machinery at Saint-Maur, represents 3½ centimes per cubic metre.

Metallic Railway Ties in Holland.

At the meeting of April 24th, in Paris, of the French Society of Civil Engineers, a paper by M. Post, of Holland, upon "Metallic Railway Ties" was noted by M. Auguste Moreau, who said that the author first referred generally to the growing scarcity of wood for this purpose, and the urgent necessity of providing a substitute therefor; he mentioned that M. Post had regretted that the study of this subject should have been so much delayed in France.

According to the author of the paper discussed, the principal advantages inherent in the new system, advantages based on an actual trial of about twelve years in Germany, etc., were:

1st. The average durability of the ties remaining in the track after 12 years use, is much greater with metallic ties of a good design than with the best wooden ties.

2nd. Safety is better guaranteed, as the gauge is better preserved.

3rd. The expense of maintenance is decreased after the second year of service, while with wooden ties this item increases with the age of the ties.

4th. That the system is being rapidly perfected, so that the fastenings are being made absolutely certain and less expensive for repair and maintenance than the fastenings used with wooden ties.

5th. The value of the metallic tie when worn out in service, is much greater than the value of an old wooden tie.

In summing up these advantages and combining them with the actual cost of purchase, redemption and interest, M. Post concludes that no country can exclusively use wood for this purpose with true economy; and he cites Holland as a proof of his assertion, where wood is still easily obtained and manufactured, iron is not too plentiful. He says *all* the Holland companies have adopted the metallic tie.

The first ties failed from being too light in section: as the engineers had originally endeavored to give them such a weight that they would not exceed wooden ties in first cost. By so doing they fixed upon a weight of from 60 to 66 pounds for each tie; this was insufficient, and the portion of the tie supporting the foot of the rail was particularly weak.

The reasons given for the failure in the last named parts of the tie were: The openings in the tie for the attachment of the fastenings sensibly reduced the section; the punching made the metal break in the neighborhood of these holes, especially when hard steel was used; the foot of the rail and the fastenings imbedded themselves in time in the upper surface of the tie; the shock from passing wheels was transmitted to the portion directly under the tie and in several types of ties, this part is weakened by the manufacture and by bending, being either bent cold, or stamped hot to give it the inclination of 1 in 20 in its length.

To overcome these disadvantages the weight of the tie was finally increased to 165 pounds, but these ties while giving excellent results in practice proved to be too expensive. Many attempts were then made to reinforce the weak points by means of plates or saddles attached by rivets, bolts, keys, etc.; but these more complicated accessories again increased the cost of the tie, and the reliability of contact between the rail and tie, became less certain than when the rail rested directly on the tie.

As a result of all this experience and trial, M. Post described the type of tie having the fewest weak point and disadvantages: The base of his process consisted in so rolling the metallic tie that on leaving the rolls it already had the wished for inclination of 1 in 20 on the upper surface, and the parts intended to carry the rail were already sufficiently reinforced with an extra thickness of metal. In section the tie resembled a letter U reversed, and more or less widened out at the base. He preferred the section adopted on the Netherland State railways, in which the tie does not exceed 110 pounds in weight, is easily rolled, presents a large surface of contact to the foot of the rail, and is readily tamped with any kind of ballast. (See ENGINEERING NEWS, March 8, 1884, for sections of various metallic ties.)

In the manufacture of this tie mild steel

(Thomas or Bessemer) was used to avoid the dangers of fracture arising from punching or stamping in hard steel. For the same reason the rectangular holes have their corners and edges rounded, and the fastening bolts have correspondingly rounded edges on their heads. Before closing the ends of the ties by stamping the metal is annealed.

The fastening is simple and certain, but can not be very well described without an illustration. The slipping of the rail longitudinally is stopped by the use of clamps connected with the rail joint.

The spacing of the ties is about the same as for wooden ties; there are ten to a rail 9m. (29.52 feet) long, the mean distance between centers of ties being 962m. (3 feet 2 inches) and .57m (1 foot 10½ inches) at the joint.

In commenting generally upon the system, M. Post said that on new made embankment or poor ballast, it was better to use the wooden tie; but when the bank had become solid and all settlement had ceased he favored the metallic tie, costing from 25 to 30 per cent. more than the wooden tie.

In regard to France, M. Moreau, in commenting on the regret of M. Post, said that the principal railway companies of that country were not yet entirely convinced as to the necessity of using metallic ties. They made use of excellent wooden ties which are not yet too costly, and in hard wood, creosoted, they would last from 20 to 25 years. Under these conditions their enthusiasm for the new system was not pronounced.

Translated for ENGINEERING NEWS.

Performance of Engines and Cost per Mile Run.

The Louisville & Nashville R. R. Co is issuing a monthly statement of the performance of engines and cost per mile run for its main line and all its branches that is not only extremely valuable for the securing of greater efficiency on its own lines, but is also important in the information contained to all interested in the management of railway plant.

The statement itself is a vast mass of tabular matter impossible to reproduce in the space permitted us, as it includes the details of the working of a system of railroads covering 2,162 miles. Some abstracts however are given below from the recapitulation.

The figures used are the *average cost per mile run*, repairs and running expenses and *average* consumption of coal and oil over all the lines in the system for the month of April, 1885, divided as follows:

	Passenger Service	Freight.	Mixed trains.	Switching.	Work trains.	Average for all service.
	CTS.	CTS.	CTS.	CTS.	CTS.	CTS.
Ordinary Repairs	2.51	5.15	1.45	2.39	4.00	3.62
Engineer and Firemans Wages	4.68	6.47	6.31	4.47	6.34	5.49
Watching and Cleaning	.83	.84	.79	.....	.41	.64
Expenses in Engine house	.77	.89	.57	.78	.....	.76
Oil and Waste	.26	.28	.29	.26	.24	.27
Water Supply	.36	.57	.35	.26	.69	.43
Fuel	5.10	7.04	5.29	3.19	4.79	5.51
Total running Expenses	12.00	16.00	13.60	8.96	12.47	13.10
Total Repairs and Running Expenses	14.51	21.15	15.05	11.35	16.05	16.72
Pounds of coal burned per mile run.	52.62	83.27	47.45	38.34	64.37	62.67
Miles run per Pint of oil.	13.37	13.29	13.26	15.14	11.62	13.75

In this system the maximum gradients vary on the various divisons from 46 to 105 feet per mile; the average grade is from 7.6 to 22.2 feet, this average grade being found by dividing the aggregate height of all the grades by twice the length of the line in miles. A modulus of curvature is given, equal to the average angle turned through in running 1000 feet; thus the power consumed in drawing a train over 100 miles of road with modulus of curvature equal to 10, would haul the same train over, 110 miles of tangents. The moduli here given range from 2° to 19°.

The following tables give other data useful in forming a general estimate of results as here scheduled, the totals are for the entire system of 2,162 miles as before:

ENGINE PERFORMANCE, APRIL, 1885.

Passenger trains, total miles run	311,824
Freight " " "	436,291
Mixed " " "	27,210
Switching " " "	219,636
Work " " "	25,834
Total Engine Mileage	1,020,795
Number of Engines on Passenger Service	86
" " Freight and Mixed	199
Average Mileage of Passenger Engines	3,626
" " Freight and Mixed Engines.	2,330
" " Each engine	2,720
Mileage of Coal burners	1,004,777
" Wood "	16,018

Note:—Switching engines are allowed 6 miles per hour.

CAR PERFORMANCE, APRIL, 1885.

Passenger, Baggage, Express and Mail, total mileage	1,383,780
Sleeping Cars, total mileage	448,171
Passenger trains, total mileage	1,831,951
Freight cars, loaded, total mileage	5,479,266
" " empty, " "	2,082,028
Per cent. of empty freight cars of all hauled	27.54
Average number of cars in each pass. trains	5.55
" " " " Freight train	14.63

Note:—Five empty freight cars are rated as three loaded cars.

RESULTS, APRIL, 1885.

Coal burned per passenger car mile	9.85 lbs.
" " " " freight " "	5.65 "
Average cost per passenger " "	2.52 cts.
" " " freight " "	1.21 "
Average gross weight, passenger trains, with engines	178.20 tons.
Average gross weight, freight trains, with engines	295.67 tons.
Average cost of oil per gallon	27.57 cts.
" " " coal per bushel (80 lbs.)	6.78 "
" " " wood per cord	$1.97

NOTE:—In arriving at Pounds of Coal burned *per car mile*, the mileage made and coal burned with mixed trains, and the coal burned in way-switching is included in freight. The coal burned while switching in yard is omitted.

The figures from which all this tabulation is made are furnished by the Accounting Department of the Company and they include *all expenses* chargeable to motive power accounts. Cost of rebuilding engines is included in the repairs.

The Telehydro-barometer.

Some-time ago we had occasion to speak of the very useful application of electricity to the continuious record of height of water in dams, etc, and the transmission and printing of this record on a dial located at any desired distant point.

We mentioned at the time that an instrument had been constructed by the Telemeter Co. for the Holyoke Water Power Co., of Holyoke, Mass; and from a late letter of Clemens Herschel, the hydraulic engineer of the Company, we are enabled to give some further particulars as to its use.

Mr. Herschel says that the instrument has been in continuous operation for two months; that it conveys its record one-half mile, from the dam to the office: that he believes it may be relied on to constantly show on the office dial the state of the water at the dam; that he is convinced of the palpable value of this continuous record of water heights as compared with the four daily observations formerly taken, and that the company has shown its faith in the machine by ordering another to indicate in the office of the Superintendent of the Gas Works, the height of the gasometer bell, at South Holyoke, one and one-half miles distant.

As used at Holyoke, the transmitter is located at the dam with the transmitting mechanism in a japanned-tin case, perfectly protected from dust and moisture. On the back of this case is a grooved brass wheel, which is revolved in one direction by a wire attached to a float, and in the opposite direction by means of a counter shaft and weight. The pulley communicates its motion to the mechanism within and the record is thence transmitted by the electric current to the receiver in the distant office.

On both transmitter and receiver are dials, for the fractional divisions, 9½ inches in diameter, and for the even feet, 2¾ inch diameter. In the office-receiver the secondary dial carries alarm-hands for ringing a bell when the water has reached any desired limit. The recording dial is 14 inches in diameter, and the record is distinctly written in an indelible ink. Three insulated wires connect the transmitter and receiver, and these are operated by a battery of prism Leclanche cells, placed in the office and requiring no attention.

In the two classes of instruments made, one indicates heights in feet and inches and the other in feet and decimals of a foot. They can be made to record up to 40 feet, with a dial division of from $\frac{25}{1000}$ to $\frac{1}{10}$ feet, and a scale of record ranging from 1 inch to $\frac{1}{4}$ inch to 1 foot; the indications and record are accurate to two thirds of one dial division.

The price of an instrument complete, without wires, is $325, and $350, as it is without or with a recording dial. For any further particulars concerning this novel and useful machine interested parties are referred to the Telemeter Co., Washington Building, New York City.

PERSONAL.

JOHN R. NIERNSEE, the leading architect of Baltimore, died June 8 at Columbia, S. C.

CHARLES H. HASWELL, the well-known civil engineer, has been elected a member of the Institution of Civil Engineers of England.

W. B. EVARTS has resigned the position of Chief Engineer of the Minnessota & Northwestern R. R.

FELIX S. PRENDERGAST, late consulting engineer of the Savannah, Florida & Western R. R., died at Savannah, Ga., on June 4. Mr. Prendergast was 37 years of age.

WILLIAM S. SMITH, a Civil Engineer and a native of Louisville, Ky., died on June 3rd, of consumption. Mr. Smith had been engaged professionally in Mexico for some years.

MR. E. L. BROWN was elected on May 27 to the new office of City Engineer of Brockton, Mass.; he has been connected with the public works of that city for some years.

A. G. MENOCAL reported to the Secretary of the Navy, on June 3rd, the arrival of himself and party from Nicaragua, where he has been making new surveys for the interoceanic canal.

JOHN RAPELJE, late assistant engineer on the N. Y., Lake Erie & Western, has been appointed general roadmaster of the Denver, South Park & Pacific R. R.

MR. JAMES MCC. CREIGHTON has been appointed superintendent of the Baltimore & Philadelphia division of the B. & O. R. R. He will also be president of the Schuylkill River East Side railroad company. Mr. H. P. Harris has been appointed superintendent of the Pittsburg division.

A. H. EVANS has resigned his position as Division Superintendent of the N. Y. Chicago & St. Louis R. R., with late headquarters at Fort Wayne, Ind. MR. C. D. GORHAM, late of the Penna. Chicago & Northwestern, and of the N. Y., West Shore & Buffalo railways is to succeed Mr. Evans.

CAPTAIN F. V. GREENE, U. S., Eng. Corps, is spoken of as a probable successor to Major Lydecker as District Commissioner of Washington, D. C. Other reports give it that Capt. Greene is only to succeed Major Lydecker as

far as the charge of work in connection with the water-works is concerned.

W. W. EVANS, who for the past 30 years has been acting as inspecting and consulting engineer for several of the republics of Central and South America and for works in Mexico, South Australia and New Zealand, has recently been appointed as one of the members of an Engineering Commission to report on the plans of a proposed railway bridge across the Hawkesbury River in New South Wales, Australia. This commission was to consist of Sir John Hawkshaw, Col. Douglas Galton and Mr. Evans, but owing to ill health the latter gentleman has been obliged to decline the honor conferred him. This Hawkesbury Bridge will be exceptionally difficult in the matter of pier foundations; the water in some places is 77 feet deep and the mud and sand 125 feet. Some of the piers will have to be sunk 170 feet below tide.

American Society of Civil Engineers.

ANNUAL CONVENTION OF 1885.

The arrangements for the Convention remain as stated in the previous circular. To secure the arrangement for transportation and for hotel accommodation, members who intend to be present and have not already notified the Secretary, should do so at once.

The sessions at Deer Park will be held as announced. The excursion to the Cheat River Grade, Kingwood Tunnel, Tray Run Viaduct, and other points on the Mountain Division of the Baltimore & Ohio R. R., will probably occur on Thursday. There will be a banquet on Friday evening.

The Baltimore and Ohio Railroad Company over its entire system, also including the Ohio and Mississippi Railroad from St. Louis and Louisville, will sell round-trip tickets for one fare going and returning. This will extend to Baltimore and Washington on the east, and Cincinnati, Chicago, St. Louis, Louisville, Pittsburg, Columbus and Toledo on the west. The presentation of a certificate signed by the Secretary of the Society will secure these tickets.

All members wishing to secure reduced transportation between New York or Philadelphia and Baltimore, *en route* to the Convention, should notify the Secretary at the earliest possible moment, as a special order from the railroad for this purpose has to be secured through the Secretary for each person.

Upon the presentation of these orders at an office of the Pennsylvania Railroad in New York or Philadelphia, tickets can be secured at round trip rates to Baltimore and return at two cents per mile.

Members on lines of New York Central and West Shore Railroads, can avail themselves of the present low rate of one cent per mile to New York. From New York the above mentioned orders can be secured if notification is sent to the Secretary in time.

No arrangements have yet been secured East of New York.

The following papers have been presented in addition to those previously announced:

"Power Brakes for Freight Engines and Cars," William P. Shinn; "Railroad Organization," Charles Latimer; "Cause and Prevention of the Decay of Building Stones," Thomas Egelston; "New Method of making Conventional signs on Topographical Maps," J. A. Ockerson; "Rainfall and Rain gauges. Presentation of a few data," Robert Fletcher; "Specifications for Strength of Iron Bridges," Joseph M. Wilson; "English and American Railroads Compared," E. B. Dorsey; "Vibration of Bridges," S. W. Robinson.

A number of written discussions on other papers have been received.

The report of the Committee on the Preservation of Timber is ready, and will be presented and discussed.

The following summary of the substance of the Report of the Committee on the Preservation of Timber is issued for the information of members. The report will be presented at the approaching Convention.

After a brief statement of the labors of the Committee and of the evident necessity for the introduction of preserving processes on account of rapidly diminishing supplies of timber, a short history of the progress of the art is given, showing three principal methods of working, viz.:

1. Steeping.
2. Vital suction or hydraulic pressure.
3. Treatment in close vessels by steaming, vacuum, pressure, etc.

The experience in the United States is given in five tables, comprising the results more or less conclusive of 142 authenticated trials or experiments. In each case these are referred to at more or less length in the text, sufficiently to give the reasons for success or failure, and the lesson taught. The five heads corresponding to the tables are:

1. Kyanizing, or use of corrosive sublimate.
2. Burnettizing, or use of chloride of zinc.
3. Creosoting, or use of creosote oil.
4. Boucherie, or use of sulphate of copper.
5. Miscellaneous, or use of various substances.

Of the first, *Kyanizing*, it is stated that an absorption of four or five pounds of corrosive sublimate per thousand feet, b. m., is considered sufficient, and it would now cost about $6,00 per 1,000 feet, b. m. It is not recommended except in situations where the air can circulate freely about the wood, as in bridges and trestles, but in very damp locations (as for ties when in wet soil and pavements), its success is doubtful. Its cost when first used led to cheating, which for a time brought discredit upon it.

Burnettizing the committee do not consider the best adapted to use where the timber is exposed to the washing action of water (as this removes the preservative); but, on account of its cheapness, it is probably to be preferred at the present time to any other process for the preservation of railroad ties. The Wellhouse, Thilmany and other modifications of the process aim at making the chloride insoluble, but are yet on trial. This process has been largely and successfully introduced in Germany. Experience shows the life of soft wood ties to be doubled and trebled by its use. Its cost in this country is about $5 per 1,000 feet, b. m., or 20 to 25 cents per tie, and for the latter purpose the committee particularly recommended it.

The work must be well done; but some of the failures were from doing it *too* well, that is, from using solutions of too great strength, thus making the timber brittle.

A solution of 2 per cent. by weight of chloride of zinc in water is recommended.

Creosoting, or the injection of timber with hot creosote oil in a cylinder under pressure, is considered to be the very best process which has been fully tested, where *expense* is not considered. It is as yet the only one known which is sure to prevent the destructive attacks of the teredo or other marine animals, and to give absolute protection against decay in very wet situations. It is a somewhat expensive process, requiring for protection against the teredo from 10 to 20 pounds per cubic foot of timber, and costing from $12 to $20 per 1,000 feet, b. m. For resisting decay alone a cost of $10 to $14 is sufficient.

The *Boucherie* process, in which green timber is impregnated with sulphate of copper either by *vital suction*, *hydraulic pressure* or a *vacuum*, when well done, suing a solution of 1 pound of sulphate to 100 of water, has proved fairly successful.

Under the head of "miscellaneous," are classed 41 experiments with almost as many substances, sulphate and pyrolignite of iron, lime, resin oil, tar, etc, but with as yet no commercial success.

The general principles laid down are, to select the process with reference to the subsequent exposure. Use *open-grained*, *porous* timber, for that reason in *general* the cheaper woods.

Extract the sap and water to make room for the material to be injected, natural seasoning, except for the Boucherie process, being very desirable. Steaming takes the place of seasoning.

Use enough of the antiseptic to insure a good result, and then let the timber dry before using, as its durability will thus be increased. Do not hasten the work if it is to be well done. Protect ties or timber in the track as far as may be from water by drainage.

Contract only with reliable parties of established reputation, under a skilled inspector, who must be in constant attendance when the magnitude of the order warrants.

There is at the close a discussion of the question. Will any preserving process pay? This is answered in the affirmative. The chairman of the committee gives a careful estimate in one of the appendices in an acetual case in this country; another general estimate is given based on European experience, and three other separate appendics give diffierent methods of examining the question of economy and comparing values.

Other appendices (to the number of twenty in all) treat of the general question of destruction and conservation of forests, and give reports of the personal experience of a number of engineers, with methods pursued, apparatus used, etc.

JOHN BOGART, *Secretary*.

Engineer's Club of St. Louis.

ST. LOUIS, May 27, 1885.

Club met at Washington University at 8 P. M.

Pres. Moore in the chair, sixteen members and seven visitors present. The Executive Committee recommended that Jos. T. Monell, proposed by Messrs. Potter and Johnson, be elected a member of the Club. He was balloted for and elected.

Mr. Winslow Allderdice of Akron, Ohio, was proposed for membership by Messrs. W. B. Potter and W. H. Allderdice.

A motion to hold a meeting of the Club, Wednesday, June 10th, 1885, was carried.

Wm. H. Bryan read a paper on Long and Short Stroke Engines, in reply to a recent publication. The relative value of these two types of engine is now being widely discussed. While the long stroke engine has done much for the advancement of steam engineering, and has heretofore been considered the ideal, he argued that it must now share the honors with the short stroke engine. On account of less first cost, interest, and depreciation; less space occupied; greater regularity of speed; less friction and liability to breakage; and at least equal fuel economy. Mr. Bryan claimed the total economic advantages are on the side of the short stroke engine. The Reynolds Corliss was taken as the type of the long stroke engine, and the Armington & Sims engine as the type of short stroke.

The paper was discussed by Messrs. Baker, Allderdice and others.

Mr. W. H. Allderdice read a paper on "The Use of Diagrams in Designing Compound Engines." The paper gave very complete mathematical discussion of the subject with black board illustrations. It was discussed by Messrs. Johnson, Baker, Moore and others.

Capt. J. H. Willard of the Mississippi River Commission was present, and gave some interesting facts concerning compound engines on Western river steamboats.

Adjourned.

THOS. D. MILLER. *Secretary*.

American Society of Mechanical Engineers.

The spring meeting of the American Society of Mechanical Engineers was opened at Atlantic City, N. J., on May 26, the first days proceedings including an address of welcome by Mayor Maxwell and a response by President Halloway of the society.

The meeting of May 27, was taken up by the reports of various committees, a lengthy discussion on the report of the Committee on Standard Boiler Trials, resulting in no definite action, and the reading of a paper entitled "Notes on the Steam Stamp," by Frederick G. Coggin, of the Calumet and Hecla Mills; "Belts as Grain Conveyors," by T. W. Hugo, and "Early Experience in the Flow of Metals," by W. E. Ward. In the evening there was a reception at Bartlett Hall.

May 28, the meeting opened by the reading of a paper by Mr. Wm. Kent on "The Torsion Balance," discussed, by A. A. and Chas. E. Emery, Hawkins, Mr. Kent and others. Mr. Allan Stirling followed with "Shell and Water-tube Boilers," and Mr. George I. Alder with "Technical Training at the Worcester Free Institute." In the afternoon a lengthy discussion took place of Mr. Stirling's paper, and then Prof. Robt. H. Thurston read his paper on "The Theory of the Finance of Lubrication." Mr. John T. Henthorn followed with "The Power required to overcome the Frictional Resistance of Engine and Shafting in Mills." The last paper of this days session was on "The Manufacture of Cotton Seed Oil," by Mr. Erwin W. Thompson.

May 29, Mr. W. H. Weightman opened the meeting with a paper on the "Oxidation of Metals," followed by John W. Anderson on "Steam Heating for Dwelling Houses," Mr. G. C. Henning on "Apparatus used in Testing Materials," Mr. Chas. E. Emery, on "The Polar Planimeter," read by the Secretary, and also an abstract of a very lengthy paper on "Trials of a Warm-blast Apparatus for Steam-boiler Furnaces," by J. C. Hoadley. The meeting closed with this last session, and was voted as one of the most successful and generally interesting and profitable of any held.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 364*).

After setting up the switch stand and putting in the other guard rail, remembering to secure the guard rails with knee braces, the turnout is ready for use. The operation is perfectly simple, nothing mysterious in it, nor any trick, as many try to believe. If it is a "point" or a "Wharton" in place of a stub switch, the method of procedure is the same, except that the "Total lead, heel to frog point" instead of "Head block to frog point" must be taken from table No. 1; and the switch itself is put in according to its own individual requirements. With a frog in a straight track some trackmen spike the gauge wide, others contract it, and the claim of both sides is that the frog rides better for it. The proper plan is to proceed exactly as if there were no frog there, for a frog should be considered a part of the rail, and spike the track opposite the frog point exactly as it is each side of it, so as to obtain a true line on both rails. If it is a turnout from a curve, leave the gauge opposite the frog on the curve the same as the rest of it, and so remember that while it is advised above to widen the gauge on the turnout side, that is not necessary because it is a frog, but because it is a sharp curve. It is well to bear these points in mind, as they have proved of much difficulty to trackmen who, as was stated before, seem to think that there is something abnormal in regard to frogs. Sometimes a frog is continually the cause of derailments, and the foreman will keep on reporting it as all right.

An intelligent examination will generally show the cause of the trouble to be one of three things. First, the guard rail loose or set too wide. Second, gauge contracted. Third, frog badly out of line. As to the cost of putting in a turnout complete, taking a No. 8 as a sample, it will occupy a gang of 8 men and a foreman one day. This includes all the work, taking out the old cross ties, putting in a set of switch ties according to the table, together with the placing of the frog, rails, etc. As to the extra labor for patent switches, 4 men and a foreman can put in a Wharton, including the ties, in half a day, and that takes more time than any of the other forms.

FENCES.

Fences form a very important part of maintenance of way. The obligations of the company in this matter are subject to State law, the same authority supplemented by county or township ordinances, regulates the kind of fence, material and height.

These regulations should be carefully studied for each locality. The styles of the fence in most general use for railroad work are the "post and board" or some variety of wire. The old fashioned "post and rail" is too expensive and English hedge takes up too much space. Therefore the first two are recognized as standards and will be treated of here. The "post and board" fence, Figure 93, consists of wooden posts set in the ground 8 feet apart so as to let the boards accommodate the market length of lumber of 16 feet. The posts should be of some timber which resists decay, cedar and chestnut preferable, and their dimensions should be 8 feet long with a diameter of not less than 4½ inches at the small end. Split posts are not as durable as the full round. The posts should be in the ground not less than 3 feet and the most stable manner is to "set" them, but for economy they are generally pointed and driven unless the ground is too hard. Probably the best practice lies between the two, by digging the hole 1½ feet and then driving the remainder, which permits of a solid tamping or ramming of the earth around the post. Before using, the posts should be stripped of the bark, as this latter, when dry, gives fire an easier chance to destroy them. The boards which should be nailed to the posts at regular spacing are usually of that lumber most plentiful in the district and which can be obtained cheapest, such as pine, hemlock, etc. The size is entirely arbitrary varying in width from 6 to 12 inches, though the thickness is almost always 1 inch.

It is common practice to have the four boards, for usually three or four of different widths, narrowing toward the top, in order to have a close fence at the bottom against small animals. This is not advisable since it renders necessary three or four different sizes of boards with consequent trouble and expense of sorting. It is a better plan to use one size and space the boards so as to gain the same effect, as shown in the figure. It is well to lay the boards on so as to have alternate rows break joints, and they should be placed on the field side of the post so that the pressure which always comes from that side may be against the post and not thrown entirely on the nails. This latter detail is frequently neglected.

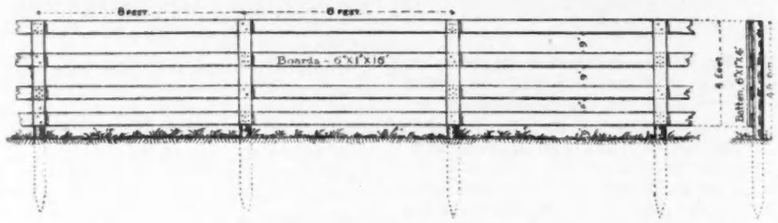


FIG. 93.—BOARD FEN

On the outside of the boards should be nailed a batten to secure the joints and hold all the boards fast. This can be made out of 6-inch stuff 4 feet long, so that one 16 foot board will make four.

The nails used should be 10d, and if battens are used 12d. The posts should be sawed off square with the top of the upper board, otherwise the uneven ends projecting up irregularly present a most unsightly appearance. Reference to Fig. 93 will show all the dimensions for a fence 4 feet 6 inches high, which height and that of 4 feet are the figures usually set forward as legal.

TO BE CONTINUED.

CORRESPONDENCE.

Whence the term "Salmon" Brick?

ALLEGHENY MT. TUNNEL, }
DOWNEY, PA., June 5, 1885. }

EDITOR ENGINEERING NEWS.—What is the ition of *salmon*, in the expression salmon brick? I do not find the word in Websters' Dictionary, but in Wheeler's Civil Engineering I find the combination sammel-brick. Sammel is also unknown to the dictionary.

C.

[We have consulted quite a number of authorities at hand without finding any reference to the origin of the term "salmon," or "sammel." We would however venture the suggestion that the first name owes its being to its resemblance in color to the flesh of the Salmon. Cresy's Encyclopædia of Civil Engineering gives *marls*, or *malms*, *stocks*, *place-brick* and *seconds*, as the names of brick according to their fineness or quality.

The *marl* is of a bright uniform yellow color, partly obtained by washing chalk with fine clay; it is used for arch-work and where rubbing is required. *Seconds* are a second quality of *marls* and are used for face-work, etc. *Stocks* are either red or gray according to clay used. *Place-brick* are of an inferior quality, being under-burned, and are only employed when soundness of work is not requisite.

Knights' American Mechanical Dictionary, under the heading of "Brick," gives "*pecking*, *place*, *sandal* and *semel* brick, as "local terms applied to imperfectly burned or refuse brick."

We would conclude from the above that the terms *Salmon*, *Sammel*, *Semel*, and *place-brick* are synonymous terms of quality, and purely local in origin. An English engineer tells us he never heard of the expression *Salmon*, as applied to brick, in England. We send the query afloat with the hope that it will meet the eyes of some one better posted than ourselves on the original use and locality of the above terms.—EDITOR ENGINEERING NEWS.]

A Gold-finder Wanted.

The following letter was actually received by Mr. G. S. Woolman, dealer in engineering supplies in this city. We give it *verbatim et literatim* as showing the simple faith in science entertained by certain citizens of the Far West.—ED. ENG. NEWS.

KULLY CHAHA, I. T., May 26, 1885.

Mr. G. S. Woolman:

Dear Sir i received your Catalogue i Dont see anything that will sute me But one Cumpass & that is too hie for the use i have for it i will try to explain to you what i want if i can i want something on a Cheep order that i can find Gold or Silver with i see you have the Miners compass for Tracing iron Ore Can i get something on that order for hunting Gold or Silver & then i see another cumpass Geological Compass wich speaks of Dip in Rocks i want something that will work to Gold or Silver they air rod that will work to silver or Gold or rite to me what you have that wil Answer that purpurs & the most reliable thing Something on a Cheep order hoping to hear from you soon

yours respectfully . . .

*Copyright by ENGINEERING NEWS PUBLISHING Co. All Rights Reserved. This article was commenced on October 4, 1884.

A Simple Process for Placing Concrete Under Water.

Translated for ENGINEERING NEWS.

The *Annales des Ponts et Chaussées*, for April, 1885, contains a descrrbtion by H. Heude, of a simple method of placing concrete under water, as adopted at the bridge of the Blois and Romorantin R. R. over the river Loire.

The foundations for the piers were piles driven into the sand and projecting some distance above the bottom and then enclosed in sheet piling, and these pile-heads were imbedded in cement beton, being completely covered. The piles were spaced about 4 feet between centres, and the employment of the ordinary concrete boxes was difficult, if not impossible; there were about 4½ feet of water over the pile heads.

In this immergency a square tube of planks was built, 16 inches on a side, and this was let down vertically into the water with its upper end about 5 feet above the surface. This tube could be raised or lowered by means of a winch, to which it was suspended, running on a staging covering the pier-site; a chain attached to the bottom of the tube allowed the workmen to deflect it when necessary.

In using this tube it was allowed to rest on the bottom where the concrete was to be deposited and then filled from above; when filled the tube was lifted by the winch and the concrete poured out at the bottom. The tube was shifted to the next position by the chain mentioned, lowered, and again filled and emptied.

The advantage lies in the fact that the concrete reaches the place of deposit without coming in contact with the current. One precaution only is required, but it is essential; and that is to watch that when the tube is lifted the top of the beton has not a level lower than that of the water.

This operation proved simple and rapid; it was possible to deposit the concrete at any spot among the piles, and continuous beds of from 1 foot to 16 inches in thickness were placed with ease. As to the objection, that the first beton thrown into the tube filled with water is diluted, the answer is that this is true but the quantity thus diluted is very unimportant. To obviate this objection a plank diaphragm can be fitted to the tube and held by cords so that it will descend as the tube is filled, thus keeping the surface of the concrete always above the water; when the bottom is nearly reached the cords which hold the plank are pulled obliquely and draw out the diaphragm from under the tube.

At the bridge noted 60 cubic metres, (78 cubic yards) were put down in one day by this tube; and though the same price was paid the contractor as for work with the ordinary concrete-box, he acknowledged that he made a round profit from the use of the tube suggested by the engineer.

Electric Tramcars.

A paper on "Electric Tramcars" was read by Mr. A. Reckenzaun before the Institute, May 18. After a comparison of horse, steam, and compressed air traction, with electrical traction, the difference of thee lectric tramcars from electric tramways and railways was pointed out to be that, whereas in electric tramways the energy is conveyed from the generating station to the rails or other conductor communicating with the motor which turns the car-wheels, the electric car carries its own energy within itself, and is quite independent of external influence, and the car can travel over any road or rail for whatever system, ordinary or specially designed. For tramcar propulsion it is absolutely necessary that the motor should have high efficiency, and at the same time be of small dimensions and light weight.

An improved machine of the author's had these qualifications. For the car there are two motors, each capable of working up to nearly nine horse-power, and weighing 420 lbs. Each motor is carried separately upon a small bogie, in such a way that each bogie forms a small locamotive engine upon which the car rests. One axle of each bogie is a driving axle; thus are actuated four small driving wheels. The speed of the motors is high, about 1,000 revolutions per minute when the car is running at seven miles an hour. Thus it is necessary to introduce reducing gear between the motor shaft and the driving axle. The gearing employed is a worm on each motor shaft, and worm wheels on the driving axles giving a ratio of about one to twelve. This worm-gearing is cased in and the wheels work in oil, the lubrication being perfect.

The variation of speed and power is obtained by means of a compound switch, which arranges the motor circuits so that the machines shall work in series, in parallel or singly; thus the resistance of the circuit being varied, the power and speed vary accordingly; when a greater range of speed is desirable, the motor-circuits are still further divided by arranging the field-magnet wires apart from the armatures. This obviates cumbersome gearing, which would add to the weight and the expense, increasing first cost and the maintenance as well. Brake-power, both mechanical and electrical is efficiently applied. The most economical steam tramway locomotives, burn from nine to eleven pounds of coal per mile. The coal for charging the electric tram-car batteries, amounts to four pounds per indicated horse-power. Reckoning the coal at eighteen shillings per ton, the fuel per car-mile would be less than one penny.—*London Architect.*

LITERATURE.

"*Healthy Foundations for Houses*," *with 51 illustrations.* By GLENN BROWN, Architect, Associate American Institute of Architects. Van Nostrand Science Series, No. 80. Price 50 cents.

This is a well written book on an important subject, appearing first in the *Sanitary Engineer* for 1884, and now reprinted with some additional matter, and new illustrations by the author. The range of subjects covered, includes natural foundations with the characteristics of the various rocks and soils; drainage, with description of the various types of drains, and manner of locating and arranging them; foundation walls of many kinds, with means for preventing dampness, etc., and miscellaneous matter relating to impervious coatings interior and exterior facing, cellar floors, roof-water, etc., The illustrations are an especial feature in this work, being very numerous and well executed.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.: M. INST. C. E.

(CONTINUED FROM PAGE 365.)

DCCLVI. ONEIDA, N. Y.

Oneida, Madison Co., N. Y., in lat, 43° 05′ N., long. 75° 50′ W. It is well known as being the house of the "Oneida Community" composed of about 300 men and women residing on a fruitful farm, all property being held in common and marriage prohibited.

Water-works were built in 1883, by a private company, taking the supply from surface water. A dam built across a stream forms an impounding reservoir covering 6½ acres, the depth of water at the dam being 28 feet, holding 24,000,000 gallons, and being 2¾ miles distant from, and 190 feet above the village.

Distribution is by 10 miles of cast-iron pipe, with 68 fire hydrants. Service pipes are of lead. The number of taps is not stated nor is any financial statement made. The population in 1880 was 3,934. J. W. Warner is President of the company.

DCCLVII. ORANGEVILLE, ONT.

Orangeville, is in Dufferin, Co., Ontario. Water-works were built in 1876, by the town. the supply being taken from surface water. Two No. 4, Holly Steam pumps are used, and lift the water to a reservoir, whence it is distributed by ¼ of a mile of 6 inch cast-iron pipe, with 7 fire-hydrants. The works are for fire protection only, and have cost $10,000, which is the amount of the bonded debt at 6 per cent. The yearly expenses of maintenance are $600. The population is 1,850. Wm. Sutton is Engineer of the works.

DCCLVIII. OROVILLE, CAL.

Oroville, Butte Co., California, is in lat. 39° 45′ N., long. 121° 40′ W. It has not been incorporated. Water-works were built in 1878, by a private company, taking the supply from Butte creek.

The water is conveyed to the town in a ditch, and is distributed by 5 miles of sheet-iron pipe, with 22 fire hydrants and 200 taps. Service pipes are of wrought-iron. There are no meters in use. The town does not pay for fire service. The daily consumption is, for five months in the year, 700,000 gallons, and for the remaining seven months 150,000 gallons.

The works have cost $25,000. There is no bonded debt. The yearly expense of maintenance is $3,000. The receipts are not given. The population in 1880, was 1,743.

John J. Smith is President, and E. W. Fogg, Secretary of the company.

WATER.

LEXINGTON, TENN., is discussing the question of constructing water-works.

ADAM MCALPIN was elected Assistant Superintendent of the Columbus, O., water-works, on June 5th.

THE bill proposing a canal to connect the Baltic and North seas, presented in the Bundesrath on June 4th, was prepared by Prince Bismarck.

GOVERNOR PATTISON, of Pennsylvania, has vetoed the Bill giving Philadelphia the power to use the $3,000,000 Gas Fund surplus for the extension of its water-works and the building of the Market St. Bridge.

THE Baton Rouge, La., *Truth* urges the necessity of sanitary work in New Orleans, and believes money spent in that direction would prove the best investment the business men of that city cou d make.

DISTILLED water saturated with oxygen is now prepared in Paris, and is rapidly gaining favor. Aside from its healthfulness for ordinary table use, it is said to be valuable in the treatment of diseases of the digestive organs.

COMMISSIONER of City Works Fleeman of Brooklyn, has arranged to turn on an additional supply of water for the city. He has perfected several miles of water mains, and calculates that from 1,000,000 to 10,000,000 of gallons of pure water additional per day will be ready for use at the end of this month. The whole system of water supply for Brooklyn will take five years to perfect.

THE pumping machinery of the New Orleans Water-Works Company consists of two beam and flywheel engines built by the Novelty and the Allaire Works of New York, and a 5 million gallon Knowles pump. Under the new contract with the company, the city pays $60 per annum for each hydrant. The officers of the company are A. Baldwin, President, L. H. Gardner, Superintendent, and R. L. Macmurdo, Secretary.

CHICOPEE, MASS., is to have a new water supply. An underground reservoir, or pump well with a capacity of 20,000 gallons will be put in, and a large brick building will be erected, containing two duplex pumps with a capacity of 800 gallons a minute. A wrought-iron receiving tank will be put in, capacity 212,000 gallons; also 8 and 12 inch mains leading to the reservoir of the Chicopee Water Company.

AT a recent meeting of the Montreal Water Commissioners tenders were received for a new pumping engine, as follows: The Corliss Engine Company, an engine of 10,000,000 gallons capacity, at $50,000; 8,000,000 capacity, $42,000. Knowles Company, 10,000,000 capacity, $50,000; 8,000,000 capacity, $45,000. Reliance Works, 8,000,000 capacity, $57,000; 10,000,000, $75,000, and an engine with all the latest improvements, of 10,000,000 capacity at $75,000. H. R. Worthington, 8,000,000 capacity, $37,500; 10,000,000, $50,150. Holly Works Company, 8,000,000 capacity, $44,000; 10,000,000, $47,500. G. F. Blake, 8,000,000, $38,506; 10,000,000, $42,000. The representatives of the Holly Works and H. R. Worthington were present and explained the capabilities of their respective engines.

SUPERINTENDENT HARSHAW states that the Oshkosh, Wis., water-works pumps are now pumping daily something over 600,000 gallons of water.

THE INGERSOLL ROCK DRILL CO., of New York, are now building several of their Straight Line single air compressors, for use in purifying water by æration, according to the method suggested by Prof. Albert Leeds of Philadelphia. The compressors will be used by the Philadelphia Water Department, for introducing the process on an extensive scale in that city. The Ingersoll compressor has been found to be especially well adapted for the use mentioned, and three of them have already been delivered in Philadelphia, and others are to follow.

The success of this ærating process has been well established by extended experiments at Philadelphia and Hoboken, and those owning and controlling the patents, have organized a company called the "United States Pure Water Co.," with headquarters, at present at No. 10 Park Place, N. Y.

THE increase in the consumption of water at St. Louis, Mo., due to the hot weather, has already become apparent in the reports from the reservoir. June 3, the water registered 175.3 feet, and June 4, 172.6 feet, a decrease of about 2½ feet. This falling off represents just about 7,814,070 gallons, and as the engines have been working steadily all the time, the decrease is to be set down to nothing else but the increased demand for water. It is estimated that during the summer weather the average daily consumption will be about 30,000,000 gallons a day. The average daily consumption of water at those city institutions provided with meters was 244,275 gallons, as opposed to an average of 252,800 gallons per day during the month of April.—*St. Louis Globe Democrat.*

TWENTY-EIGHT Italian laborers were arrested at Stapleton, on Staten Island, for violating the Sunday law. They were employed by the New Brighton Water-works to dig excavations to lay mains in Edgewater. The Chrystal Water Company, which is in opposition to the New-Brighton Company, already have water mains laid through Edgewater. Trustee Thomas Brown, of that town, refused to allow the New-Brighton Company to lay their pipes. Trustee Brown, however, sailed for Europe on Saturday, and the New Brighton Company took advantage of his absence to put the Italians to work early yesterday morning digging on Canal and Water streets in the front and rear of the Trustees premises. The Italians were released on their own recognizance to appear for trial this evening.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

Proposed Georgia R. R.—A scheme is on foot to build a railroad from Brandford to Deadman's Bay, Ga.

The Deadwood and Redwater Railroad, of Dakota, will be a narrow gauge. It will cost $300,000, and surveys for the same have already commenced.

Cross-ties for Engine Fuel.—The Pennsylvania Company now gather up all their old cross-ties, cut them in two, split them up, and when dry use them in firing up their engines.

English and American Steel Rails.—At this time there is a difference of only $2.87 between the British price of steel rails, $22.12, and the price at which steels rails were sold in Philadelphia last month.

Kentucky and Indiana Bridge.—Several car loads of steel superstructure for the Kentucky and Indiana bridge arrived in New Albany, Ky., June 5th. The work of putting up the false work will probably be commenced soon.

The Cheapest Railway in the World is in Prussia, namely, that from Thorn station to Thorn City, across the famous bridge over the Vistula, a third-class ticket costing 5 pfennigs, equal to 5¾ cents United States currency.

The Aransas Pass Road.—SAN ANTONIO, TEX., June 2nd.—The contract was let to-day for ten miles more grading on the San Antonio and Aransas Pass Railway. This will carry the road to Floresville, Wilson County.

Engines For Panama.—PITTSBURG, Pa., June 6.—An order has been placed by the Universal Inter Oceanic Panama Canal Company with a firm of builders of this city for six locomotives, upon which the firm are now at work.

Wilson and Fayetteville Branch R. R.—The contract for building fifty-nine miles of the Wilson & Fayetteville branch of the Wilmington and Weldon (N. C.) Road has been let to Montgomery, Wright & Co., of Birmingham.

The Heaviest Locomotive, of which there is any record is a passenger tank engine of the Pennsylvania road; its weight is stated to be 120,000 pounds, but the driving wheel is only 60 inches in diameter. The fast express engines on the same road have driving wheels 78 inches in diameter.

The Bridge at Henderson across the Ohio river and the Northwestern railroad, will be completed about June 15th.

South Mountain R. R.—There are rumors of the resumption of work on the South Mountain R. R., upon which, between Hamburg and Allentown, Pa., the P. & R. R. R. spent vast sums of money in 1869 and 1870. The line if completed would be the air-line between Harrisburg and New York and Boston.

South Penna. R. R.—The $20,000,000 mortgage of the South Pennsylvania railroad filed June 2, in Pittsburg Pa., indicates that the managers of this project mean business in pushing the road to completion. It may also be remarked that it means business in the usual line of piling upon a big capitalization as the superstructure of the project.

B. R. Bridge Destroyed.—The Northern Pacific bridge consisting of three 100 foot spans, over the West Gallatin River, at Central Park, eighty miles east of Helena, Mon., was completely washed away, lately, and no Eastern Mail has arrived at Helena over the Northern Pacific Road since Sunday. The transfer of mail and passengers by ferry has began.

Trustees for Reading.—The Philadelphia and Reading Railroad has agreed upon its two trustees under the Bartol-Whelan plan of reorganization. They are H. McK. Twombley, a son-in-law of W. K. Vanderbilt, and H. A. DuPont, president of the Wilmington and Northern Railroad. Mr. Twombley has not yet accepted the position, desiring to first await the arrival of Mr. Vanderbilt from Europe.

The Atlantic & Pacific has contracted for a nine-span iron bridge across the Arkansas river at Toulson, ninety-eight miles from Seneca, Mo., on the central division of the road. The track extends four miles beyond the river, which is now crossed by a wooden bridge. Cattlemen are afraid to ship over this bridge, and therefore the new one. It will be finished in season for autumn shipments, and will cost about $100,000.

The Rock Island, it is said, will build the new railroad from Gallatin, Mo., to St. Joseph, provided St. Joseph donates $50,000 and Depot grounds, and DeKalb gives the right of way. The Cameron *Vindicator* says engineers are at work surveying the route from Trenton to St. Joseph. It is also stated a party of surveyors have been viewing the route from Gallatin to Maysville.

The Canadian Pacific has been completed to within ten miles of the summit of the Selkirks, and only seventy miles of the contract work this side of the Onderdonks remain to be finished. At present there are 5,000 men at work on the road, 1,000 having been sent out within the last ten days, and inside of a month 2,000 more will be forwarded. The line is now being operated to the first crossing of the Columbia River, a distance of 1,025 miles from Winnipeg.

The Woburn Branch Extension of the Boston & Lowell Railroad from Woburn to Wilmington, will be commenced this week. A large number of Italian laborers will be employed, and shanties are now in process of building for their occupancy. The contractors, Messrs. Brintnel & Ryan, will push the work along fast, and steam shovels will be used along the line. By the 1st of December Lowell passengers will pass through Woburn.

The Olmsted Falls & Lake Erie Railroad Company, of Cuyahoga county, with a capital stock of $10,000 filed articles of incorporation with the Secretary of State, June 3rd. The company was organized for the purpose of constructing and operating a railroad commencing at the Lake Shore & Michigan Southern depot, at Olmsted Falls, and running to Lake Erie near the mouth of Rocky River, being about nine miles in length. The incorporators are Jeremiah L. Duke, M. M. Hobart, J. B. Buxton, J. T. Brady, and N. Norton.

The Hoosac Tunnel Route.—BOSTON, June 6.—The governor has signed the Hoosac tunnel bill. By this bill the State sells to a new corporation the Hoosac Tunnel, and the Troy and Greenfield railroad, the State to take pay in the stock and bonds of the new corporation. The new corporation is practically unlimited as to the amount of its capital stock, but must file its certificates of organization within three months. The Fitchburg railroad is the backbone of the new corporation. The bill lays the foundation for a mammoth through route from Boston via the Hoosac tunnel to Chicago.

Wisconsin Railway & Navigation Co.—MADISON, Wis., June 4.—Articles of association were filed to-day with the Secretary of State of the Wisconsin Railway & Navigation Company. With capital stock of $1,500,000. The company proposes to construct a line forty-five miles in length from Green Bay to Sturgeon Bay, with two lateral branches, each fifteen miles in length, one to Kewaunee and the other to Ahnapee. The incorporators and directors are William O. Wright and M. H. Wilcoxson of Freeport, Ill.; P. L. Spooner, Jr., and F. W. Oakley of Madison, Wis.; E. S. Miner of Sturgeon Bay, Wis.; Edward Decker of Cosca, Wis.; and M. J. Briggs of Georgetown, Colo.

Tracklaying on the Sioux City and Pacific had reached a point last week sixty-six miles west of Valentine. Eighteen miles more of the sand hills country yet remain, when the fertile region of the White river slope will be reached.

Fast Time on the Pennsylvania R. R.—The Pennsylvania Railroad Company send a train out of Jersey City at 9 o'clock every morning that beats the time of the famous "Flying Dutchman." Considering the distance covered, it is the fastest train in the world. The time to Philadelphia is a trifle over 2 hours; to Chicago, 24 hours; to Cincinnati, 21 hours, and to St. Louis, 29 hours. And this speed is maintained without the slightest danger to the traveler.

St. Petersburg Ship Canal.—Work on the recently opened Russian ship canal was begun in 1878. It extends from St. Petersburg to Cronstadt. Its total length is 17¾ English miles, with greatest width 350 feet, diminishing to 220 feet, and navigable for vessels drawing 20½ feet of water. The force employed upon its construction embraced 3,500 men, 13 dredging machines, 3 locomotives with 230 cars, 86 lighters and barges, 12 steamtugs and 7 stationary engines, and the total cost to the Government was about $9,000,000, or $500,000 per mile. When the Neva river is free from ice (which is generally by May), vessels can proceed directly from the Gulf of Finland to St. Petersburg instead of discharging or taking their cargoes at Cronstadt, as heretofore.

The Oregon Railway and Navigation, expects to build two branches within the next twelve months. They will be known as the Patala and Moscow branches. The former will be about twenty-five miles in length, extending from a point near Riparin and running to within a short distance of Pomeroy. It is said the grading and tracklaying can be done for $16,000 a mile. The Moscow branch is to extend from Colfax to Moscow, a distance of twenty-six miles. Twenty miles of this has already been graded. Farmers throughout this section of country are very anxious that the branches should be built in time to move this season's crop.

Extending the Santa Fe.—RICHMOND, Mo., June 2nd.—A party of engineers under orders from the Atchison, Topeka, and Santa Fe Railway, are this week surveying a line from Sibley, on the Missouri River, to this city. It is quite probable that the survey will be continued on to Chicago. Over a year ago a charter was granted the Santa Fe Company to build a bridge over the Missouri River at Sibley, and it is quite probable that within a year the company will build the road from Pleasantville, in Cass County, to this place. The Chicago, Burlington and Kansas City, now in operation as far as Borgard, Carroli County, will, in all probability, be completed to this place by the 1st of October.

A 430 Feet Draw-Span.—The Passaic Rolling Mill and Bridge Works, of Paterson, N. J., are building what will be, when finished, one of the longest draw-span in the world. It is to be 430 feet long, will weigh about 500 tons, and consist of iron and steel in the proportion of three to two. The machinery for latching, lifting the ends and turning the draw is all to be worked from the center of the span, and is fitted to be operated by either hand or power. The turn-table is rim-bearing, turning on 50 wheels 18 inches in diameter. The diameter of the drum is 25½ feet. It is for the new bridge which the Minnesota and Northwestern Railroad Company are constructing across the Mississippi River at St. Paul. The length of the entire bridge will be 1,430 feet.

Extending the Burlington.—Ever since the Chicago, Burlington and Quincy Road reached Denver and impression has prevailed that its next objective point would be Salt Lake City. It has been repeatedly asserted that the company contemplated extending their line to Salt Lake city immediately, although these assertions have always been emphatically denied by the Burlington authorities, and it is apparent they are trying to steal a march on the rival lines.

There is no question but the Burlington Road is now being pushed from Denver to Grand Junction at a rapid rate. The route is via Hot Springs, Col., 110 miles northwest of Denver, where the Grand River is encountered from this point the route will be down the valley of the Grand to Grand Junction. The line will be about 100 miles shorter than the Denver and Rio Grande between Denver and Grand Junction, and will make a shorter route from Salt Lake City to Denver than the Union Pacific. A great deal of grading has been done between Denver and Hot Springs and along the Grand Valley. The country through which the road passes is rich in resources and contains some of the most extensive coal fields in the West.

What the Burlington will do when it reaches Grand Junction is undeveloped, but a purchase of the Rio Grande Western is among the possibilities. A very significant fact in this connection is that every bridge that has recently been built by the Rio Grande and Western is a broad gauge bridge, and the officials of that road assert that the entire line could easily be converted into the standard gauge.—*Exchange.*

The Central Asian Railway.—ST. PETERSBURG, May 31st.—The building of the Central Asian Railway is proceeding with extreme rapidity. Thirteen hundred laborers have just left Baku to work on the road, and it is reported that 6,000 more will follow immediately.

A Great Bridge for Australia.—A great railroad bridge, 3000 feet long, is to be built over the Hawkesbury River, in New South Wales, Australia. The soundings appear to show that the foundations for piers must be sent down to a greater depth than any ever sunk by man in the whole history of engineering, the water in some places being 77 feet deep, and in others, where the water is 45 feet deep, the mud and sand is 125 feet deep, makine 170 feet in all to sink the piers below tide. This bridge is to be for double tracks, and will cost over $2,000,000. Proposals to build this great bridge have been asked of the leading bridge builders of England, Europe and the United States. Sir Saul Samuel, of London, on the part of the Government, has named a board of engineers, to meet in London in June to examine and report on the plans and tenders sent in by the bridge builders. The board named consists of Sir John Hawkshaw, C. E.; Col. Douglas Galton and Mr. W. W. Evans, M. I. C. E., of New York.

A Chat on Car Wheels.—An official of the Pennsylvania Railroad stated to a Pittsburg *Dispatch* reporter that there are fully 10,000,000 iron car wheels in use on American railroads. That figure does not include the wheels on palace coaches and the better class of passenger coaches.

"How much iron does it take to make a wheel?" was asked.

"About 525 pounds of pig iron," he replied, "and about 1,250,000 wheels are worn out every year; but do not conclude from that that the iron men are called upon to supply the 312,500 tons of material required to make the new wheels, because the worn out wheels themselves supply about 290,000 to ns.

"How long will a good car wheel last?"

"Formerly it would last eight years. But now the reduction of railroads to a standard gauge and the improvement in loading and unloading facilities keep the length of service down. This is because the uniformity in gauge keeps the cars in more continuous use, and the improvement in loading and unloading facilities enable the cars to be put to more active service. The wheels on palace coaches and on first-class passenger coaches are known as paper wheels. They are made with a steel rim or flange, and iron hub, but the web is composed of sheets of paper cemented together. They combine lightness with strength.

Railroading Forty Years Ago.—Andrew Quintin, of Trenton, is at Minneapolis, Minn., as a delegate to the annual convention of the Passenger Conductors' Life Insurance Society of the United States. Mr. Quintin represents the New York Division of the Pennsylvania Railroad. He displayed before the convention a sample of the orders issued to him as a conductor in 1845. It amused everybody. The sample is as follows:

"Instructions—Trenton and Pennsylvania Railroad. Line 3—Philadelphia, December 12th, 1845. To Andrew Quintin: Sir—You will leave Trenton at 7, Bordentown, 7.30, and Burlington at 8 o'clock A. M. If no flag is up, remain on turnout till C. & A. R. R. line passes, and if no line is in sight when you get to Dank's proceed on carefully with a man ahead (at curves,) and give New York line the preference, and then continue on to Camden at regular speed; if you can, get there by 9.28 (regular time to be there 9.30.) If you cannot reach there by 9.28, stop at the deep cut, if you get there by 9.35, and remain till 9.50, if mail pilot line does not arrive. If you cannot reach deep cut at 9.50, stop at Fish House turn out till 9.55. If no line in sight, teen proceed to Camden with man ahead, as before.

WM. H. GATZMER.

"P. S. You will regulate your watch by the office clock in Philadelphia and you will take water at Rancocas when there is water there."

Railroads in the Northwest.—Disturbing influences are still at work among the railroads of the Northwest. The Dubuque and Northwestern Railroad, projected to run from Dubuque, Iowa, to a connection on the Minnesota State line near Mona with the Minnesota and Northwestern for St. Paul, is assuming tangible form. The town of Dubuque voted $300,000 to the new road, and $105,000 has already been collected out of $160,000 which, it was stipulated, should be raised before July 1' An outlet to the east is being secured by the engineers of the new road by running lines from the station grounds in Dubuque to the Illinois Central Railroad Company's bridge over the Mississippi. The new line parallels the Dubuque and Sioux City, and the Cedar Falls and Minnesota Railroads, which form the Iowa Division of the Illinois Central. The statement has been made that this is either an attempt on the part of the Illinois Central to force its leased lines to consent to modifications of the leases, or else that some other trunk lines probably the Chicago, Burlington and Quincy, will cut into the territory of the Illinois Central and realize a long cherished plan of reaching St. Paul. In the meantime the Chicago and Northwestern managers are pushing their Northern Illinois Road from Lasalle with a view of taking from the Illinois Central and Rock Island Roads a share of the coal business of the Lasalle and Perre.

A Texan Railroad.—The business men of Lancaster, Tex., are raising funds to build five miles of railway to connect with the Texas Central Railway at Hutchins.

Assessing Jersey Central.—Ex-Judge William T. Hoffman, who is conducting the State's defense against the certiorari proceedings brought by the New Jersey Central Railroad Company to defeat the operation of the new railroad tax laws, says that the case will probably be heard at a Special Term of the Supreme Court, to be held at Trenton in October, for the consideration of all the railroad tax case.

Civil Engineer E. W. S. Harrison, who assisted to make the valuations of Central Railroad property, is still engaged in giving his testimony. This morning he will proceed with the valuations of Central Railroad property in Union County. He completed all the details as to the valuations of the railroad's property in Hudson County. His latest testimony in that branch was to the piers, bridges, wharves, tracks, and station buildings of the company. The valuations placed on the highway bridges on the main line of the road vary in value from $1,300 to $2,600 each, with the exception of one bridge at Avenue A, Bayonne, which he values at $6,861. The valuations of the railroad bridges vary from $8 700 to $32,000 each, until the "Long Bridge," which carries the road across Newark Bay from Bergen Point to Elizabeth, is reached. The eastern approach to the draw of that bridge is 1,444 feet, from the westerly end of the draw to the solid ground at Elizabethport, the length is 5,700 feet. The draw rests on a center pier 35 feet in diameter, with two end piers of stone. It has a span of 215 feet and is worked by machinery worth $24,000. The value of the three piers is $64,198. The total value of the bridge and its approaches is fixed at $286,494. The value of all the bridges on the main line in Hudson County is $396,653. On the Newark and New York branch the Hackensack River bridge is valued at $90,583 and the Passaic River mbridge at $59,033.48. The value of the station the at Comunipaw terminus of the road is fixed at $12,844. The stations along the two lines—the main line and the Newark and New York branch—are valued at from $1,500 to $3,000, the Bayonne station on the main line and the Jackson-avenue station on the branch reaching the highest figures.—*N. Y. Times.*

Contracting.

Anderson, Lebanon & St. Louis R. R.—Manager Moore, of the Anderson, Lebanon and St. Louis Road, June 3, let the contract to Parker & Wilcox, for the immediate extension of the road to Lebanon.

Steam Cars to vacate Atlantic Ave., Brooklyn.—Governor Hill has signed the bill providing that the steam cars on Atlantic Avenue, Brooklyn, shall be taken off when the elevated cable road is complete.

The Extensive Car Works at York, Pa., have changed hands, the new proprietors, Gotwalt & Berry, having formerly been employes. They resumed work lately with a large force of workmen, and numerous orders on hand.

Cost of Elevated Railways.—It is stated that the cost of the ironwork of the Brooklyn Elevated Railroad erected was 3.22 cents per pound. The lowest contracts on the New York roads was 3.4 cents.

Philadelphia Sewer Contracts Awarded.—Councils' Committee on Surveys on June 4th, awarded the contracts for the sewer on Twenty-fourths Street, between Dauphin and Huntington, to James Sullivan, at $16.80 per lineal foot, while that to be built on Clearfield Street, between Thirteenth and Broad, was given to M. C. Hong at $13.75 per foot.

The West Superior Dredging and Dock Company has been formed in Superior, Wis., for the purpose of dredging St. Louis bay at West Superior and building docks. Two complete dredges, with a double complement of scows and two tugs, have already been ordered, and are expected here by the 15th inst. The officers of the company are; Gen. J. H. Hammond, of West Superior, president; Chas. Parker, of Ste. St. Marie, Mich. manager.

An Insane Asylum, is to be built for Phoenix, Arizona. The directors advertize for plans, offering the magnificent premium of $250.00 for the best plan offered before July 3. The asylum, however, is only to accommodate 100 patients and its cost is not to exceed $45,000. As a guide to architects and bidders, the directors publish with their proposal the following table of material and labor:.

Lumber per M., finishing and flooring	$65.60
Lumber per M., rough	45.00
Brick laid in wall, per M	14.00
Rockwork for basement, per perch	3.50
Iron, per lb.	.04
Lime, per bbl.	2.00
Wages.—Carpenters per day	4.00
Bricklayers per day	5.00
Laborers per day	2.00
Painter per day	4.50
Plasterer per day	5.00

The same document also contains the somewhat novel adjunct of a statement of the range in temperature per month. Designs are to be sent to N. A. Morford, Phœnix, Maricopa, Co., Arizona.

The New Albany, Ky., Rail Mills are running full blast on a large contract for rail for St. Louis parties.

The Market Sheds of Philadelphia to come down.—The Market-sheds in the streets of Philadelphia were one of the characteristic features of that city a generation ago. Those on Market St. have long since disappeared, and the sheds on Girard Avenue, west of Sixth St., are now to be removed. By resolution of Councils all sheds and stands on the streets must be removed before January, 1888.

Sinnamahoning R. R.—Messrs. McMurtry & Craigie are the contractors for the building of the Sinnamahoning R. R., running from Keating Summit, Potter Co., Pa., to Cottrell in same county, a distance of about 14 miles. Robt. Ewing is Chief Engineer, and M. L Brooks, in his assistant. The owner and builder of the roads is Mr. Frank H. Goodyear, of Buffalo, President of the United Lumber Co. The road has a grade of 165 per mile over several miles; it penetrates a region containing 14,000 acres of virgin hemlock forest.

Stone Pavements for St. Paul, Minn.—The board of public works on June 2nd, opened bids for the stone pavements to be laid in St. Paul this year. The stones on which bids were made were Berea, Kasota, Bedford, North river blue stone, Lamont, Stone City of Kansas and the Schillinger patent stone. The bidders were Lauer Bros., Cook & Hyde Stone company, George W. Reis and E. J. Bell. On Berea, Kasota, Bedford and North River blue stone, Lauer Brothers' bids were the lowest and the contract was awarded to them. Their bid was:

Kind of stone.	*Thickness—ins.	15 to 24 sq. ft. S.	15 to 24 sq. ft. P.	15 to 24 sq. ft. N S	24 to 36 sq. ft. S.	24 to 36 sq. ft. P.	24 to 36 sq. ft. N S	36 to 50 sq. ft. S.	36 to 50 sq. ft. P.	36 to 50 sq. ft. N S
Berea.	3	27			28			29½		
	4	34			35½			36		
	5	41			42			42½		
	6	47			48½			49		
Kasota.	3	27½			28½			29		
	4	34½			36			36		
	5	43½			42½			43		
	6	47½			49			49		
Bedford.	3	29			30½			31		
	4	36			39½			40		
	5	51			48½			49		
	6				57½			58		
N. river blue.	3			35½			40			
	4			37½			43			
	5		52½	49½		57½	59½		64½	64
	6		64½			70			79	

S. means sawed stone; P. means plowed stone; N. S. means natural surface.

Excavation, per cubic yard	$24.50
Masonry, per cubic yard	3.25
Brickwork, per thousand	13.75
Granite curb, per lineal foot	1.12½
Blue stone curb, per lineal foot	96
Repairing and relaying stone walk, per square foot	09
Wrought iron, per pound	01¼

Pioneer Press.

Miscellaneous.

The Ingersoll Rock Drill Co. of New York, have carried off the highest honors at the New Orleans World's Fair, where their handsome exhibit of Rock Drills, Air Compressors and other Mining Machinery attracted general attention. The judges have awarded them three first prizes, namely, a gold medal for the best Rock Drill, another for the best air compressor, and still another for the best display.

The Largest Room in the World under one roof and unbroken by pillars is in St. Petersburg. It is 620 feet long by 150 feet in breadth. By day-light it is used for military displays, and a battalion can completely maneuvre in it. Twenty thousand wax tapers are required to light it. The roof of this structure is a single arch of iron, and it exhibits remarkable engineering skill in the architect.

The Triboulet System of Photographing all the country as seen from a captive balloon is said to have succeeded well. A very small balloon carries up to the necessary height the photographic apparatus, the panoramic object-glass of which is provided with a valve, which can be opened through an electric current managed by the operator, who remains on the ground. The impressions obtained are useful for military purposes.

The New Clock Dials on the tower of the general Post Office at Melbourne, Australia, will be made of cast-iron having hemispherical recesses so placed as to mark the hours, instead of the usual numerals. These cups will be nickel-plated inside so as to reflect the sunlight, forming bright points during the daytime. After dark each will be illuminated with an incandescent lamp, and on each of the hands will be placed a close row of smaller lamps. By this arrangement it is believed that it will be possible to read the time at a great distance.

The German People, now number 45,000,000, and their present rate of increase is greater than that of any other European race. The population, which in France only increases by 26 a year for every 10,000, and in Great Britain by only 101, increases in Germany 115, and this in spite of a vast emigration.

Electric Light vs. Oil and Gas.—The elaborate experiments made by the English authorities at the South Foreland Light show that electricity is much superior to gas or oil. The electric light could be seen fourteen miles, when the others were lost sight of at eight; and, though its power is much diminished by fog, it is still superior to all other lights—a point hitherto doubtful.

The African Inland Sea.—French engineers are to begin further surveys in relation to the proposed African inland sea. Early in 1883 M. De Lesseps made a trip from the Bay of Gabes along the Oued Mellah to the Chotts, and came back fully convinced that it was practicable to make a canal from the estuary of the River Mellah to the great marsh lakes of Southern Tunis. The present expedition will make additional studies on the spot with the two-fold view of constructing a harbor at the mouth of the Oued Mellah, and of ascertaining the feasibility of sinking artesian wells along the proposed line of the canals and the best route for a service railway.

The English Billion—a million millions—has set Sir Henry Bessemer calculating. He reckons that a billion seconds have not elapsed since the world began, as they would reckon 31,678 years, 17 days, 22 hours, 45 minutes, 5 seconds. A chain of a billion sovereigns would pass 736 times around the globe, or lying side by side, each in contact with its neighbor, would form about the earth a golden zone twenty-six feet six inches wide. This same chain, were it stretched out straight, would make a line a fraction over 18,328,455 miles in extent. For measuring height, Sir Henry chose for a unit a single sheet of paper about one three hundred and thirty-third of an inch in thickness. A billion of these thin sheets, pressed out flat and piled vertically upon each other, would make an altitude of 47,348 miles.

The New French Ironclad Caimon, just launched, is intended as a coast guard of the first class. She has armor plates of Creuzot steel of a maximum thickness of 50 cm., decks covered with plates 7 cm. thick, and is provided with a movable keel to facilitate movements in shallow water. The most ingenious part of her equipment consists in the exhausting system, which secures the vessel against sinking in the event of leakage. By means of self-acting valves it is possible to connect the various water-tight compartments. Two centrifugal pumps are attached to the great collector, having an interior diameter of 36 cm., the flow of water into which is controlled by means of valves. These pumps can each raise 500 tons of water per hour. With two powerful pulsometers and the steam pumps nearly 3,000 tons of water can be thrown into the sea in an hour. The length of the ship is 87 meters.

Natural Gas in Puddling.—A correspondent of the Philadelphia *Ledger*, in an article on natural gas, quotes the following tests made by Spang, Chalfant & Co. when they introduced the gas fuel, 12 years ago, their men not being familiar with handling it at the time:

Charged.	Coal as fuel.		Gas as fuel.	
	Charge 1.	Charge 2.	Charge 3.	Charge 4.
Isabella Pig Iron	475	475	485	484
Best tap cinder	70	70	100	74
Roll Scale	120	130	145	150
Coal used	267	180	...	...
Muck bar got	446	420	475	462
Yields.	Per c't.	Per c't.	Per c't.	Per c't.
Muck bar	93.9	8.84	97.74	95.5
Loss	6.1	11. 6	2.26	4.5

The tests of the bars made by gas heat proved them superior to those made by coal.

High Peaks of the Catskills.—The following are the highest peaks of the Catskill range, and the nearest village or habitable valley in their vicinity:

	FEET.
Slide Mountain, from J. W. Dutcher's Big Indian, Ulster County	4,220
Hunter Mountain, Hunter village, Greene Co.	4,052
Black Dome Mountain, Hensonville, Greene Co.	4,004
Thomas Cole Mountain, Greene County	3,975
Black Head, Cairo, Greene County	3,965
Mount Cornell, Woodland Valley, near Phœnica, Ulster County	3,920
Big West Kill Mountain, West Kill, Greene Co.	3,900
Vly Mountain, Lexington, Greene County	3,888
Graham Mountain, Dry Brook, Ulster County,	3,886
Peakamoose Mountain, Watson Hollow, Shokan Ulster County	3,875
Table Mountain, Watson Hollow, Shokan, Ulster County	3,875
Plateau Mountain, Tannersville, Greene Co.	3,855
The Wittemberg Mountain, Woodland Valley, Ulster County	3,824
Sugar Loaf or Mink Mountain, Tannersville, Greene County	3,807
Big Indian, from Big Indian, Ulster County	3,800
Kaaterskill High Peak, Haine's Falls, Greene Co.	3 800
Panther Mountain, Big Indian, Ulster County	3,800

—From the Albany *Argus*.

Index to Periodical Literature.

Bridge.—Description of the bridge built across the Schwarzwasserbrcüke valley, Switzerland. It is of iron with an arch of 114 meters (374 feet) span; the roadway is 63 meters (207 feet) above the water, 6 meters (19 feet 6 inches) wide, and 166 meters (548 feet) total length. Plan and elevation are given and elevations of three other proposed designs. *Annals des Travaux Publics*. May, 1885, p. 1355 to 1357.

Cuttings and Embankments.—*Consolidation of loose and clayey soils.* A paper on the methods employed in different countries to make cuts and fills in soils liable to slip, safe by means of drainage, retaining walls, etc. Several instances are given. *Les Annales des Travaux Publics*, May, 1885, p. 1348 to 1351.

Dock—*Construction of a Dock at Hamburg for unloading Petroleum and other inflammable material.*—The dock is 351.50 meters (1153 feet) long and 101.50 meters (333 feet) wide, and is separated from the river by a tide-dock, the sides are earth banks, sustained by a row of piles and sheeting-piles. It will accommodate 15 ships. Cost, exclusive of sheds, etc., 1,370,000 marks ($328,800.) The method of construction are described, and plans and detail drainings given. *Les Annales des Travaux Publics*. May, 1885, pp. 1347-1348.

Construction of a Dry Dock in Quicksand.—Built under difficulties in a very limited space. Length 390 feet, width 66 feet, concrete foundations, walls of brick work. When there is no ship in it, water has to be admitted at high tide to increase its weight. Cost $325,000. *Mechanics*. June, 1885, p. 185.

Inland Navigation in Europe.—Describes the intent and commercial importance of the navigable canals and rivers of the several European countries; with remarks on their cost, freight rates, modern improvments, etc. A lecture delivered at the Institution of Civil Engineers, London, in March, by Sir C. A. Hartley, M. I. C. E. *American Arhcitect*. June 6, 1885, p. 271.

Rail Sections.—*The Proper Shape for Wheel Flanges and Rail Sections.* A consideration of the relations between rail and wheel under various conditions, by Wm. E. Partridge. Several illustrations are given, and comparisons are drawn between the different types, their merits and demerits being pointed out. *National Car Builder*. June, 1885, pp. 74, 75, 76.

Tehuantepec Ship Railway.—An address delivered by Mr. E. L. Corthell before the Franklin Institute, Philadelphia, December 28, 1884. It deals with the history and geography; describes the engineering features of construction and transportation in detail, and discusses the commercial results. Illustrated. *Journal of the Franklin Institute*, June, 1885, p. 457 to 489.

Telegraphy.—*Fac-Smile Telegraphy.*—A resumé of the different inventions in this line since 1843, with remarks on the value of such a system. Professor E. J. Houston. *Journal of the Franklin Institute*. June 1885, p. 490 to 494.

Market Report of Engineering Materials.

New York, June 11, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.9c.	@	2.2c.
Tee	2.2	@	2.25c.
Beams and channels	3.0c.	@	
Tank	1.9c.	@	2. 0c
Shell	2½c.	@	2¾c
Steel plates, Tank	2¾c.	@	3c.
WROUGHT-IRON PIPE., PITTSBURGH.			
Butt welded, black ..Discount	45	@	50
" galvanized "	35	@	40
Lap welded black "	65c.	@	
" Galvanized "	45	@	50
Boiler tubes "	60		
RAILS.			
Steel (large lots at mill)	$27.00	@	27.50
Old rails	16.50	@	17.00
Old rail steel	16.50	@	17.00
R. R. spikes	1.8	@	1.9c
R. R. splice-plates	1.65c.	@	1.75c.
R. R. Track Bolts	2.6c.	@	3c.
Barb-wire fencing, galvanized	4½c.	@	5¼c.
" painted	3½c.	@	4¼c.
Corrugated iron			
Nails			
Iron	2.25		
Steel	2,25		

METALS.

COPPER.			
Lake Superior	11.35	@	11.40
Other Brands	10¾	@	11½
LEAD.			
Com. Domestic	3.65	@	3.70
Lead Pipe	.05¾		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.06¾		
ZINC.			
Sheet	0.05	@	0.05½

BRICK.

(Cargoes afloat)			
Haverstraw per M.	$6.25	@	6.50
Fishkill	4.75	@	5.50
Up-River	5.70	@	6.00
Jerseys	5.50	@	5.75
Long Island			
" pale			
FRONTS.			
Croton red	13.00	@	14.00
" dark	13.00	@	14.00
" brown	12.00	@	13.00
Philadelphia pressed	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	40.00

CEMENT.

PORTLAND.			
Gibb's English 400 lbs. per bbl	2.75	@	2.90
K. B. & S. " "	2.85	@	3.00
Burham " "	2.70	@	2.85
Keene's fine " "	9.50	@	10.00
" course " "	5.00	@	6.00
Roman "	2.75	@	3.50
Largerdorfer German "	2.55	@	2 80
Dyckerhoff "	2.90	@	3.25
Stettiner " "	2.60	@	2.65
Hanover " "	2.60	@	2.65
Vorwohler, Lion "	2,90	@	3.25
Alsen, " "	2.55	@	2.60
Fieve " "	2.40	@	2.50
Saylor's American	2.15	@	2.40
Windsor } U. S. C. Co.	1.00	@	1.1
Standard } U. S. C. Co.			1.15
Cable's Portland }	2.15	@	2.40
ROSENDALE cements	1.00	@	1.10

LIME.

Rockland common per bbl	1.00		
" finishing	1.20		
State, common	.90		
" finishing	1.10		
Kingston, ground	0.95		
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.			
Amherst freestone, No. 1 per cub. ft.	0.90	@	95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "	0.75	@	1.00
Brownstone, Portland, Ct. "	1.00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	16.00	@	20.0
Choice "	55.00	@	80.
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.5
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2½ × 4 to 4 × in	.17	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@	40.00
YELLOW PINE, Girders "	26.00	@	35,00
Dressed flooring "	30.00	@	40.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "	2.40	@	2.50

PAINT.

Lead, white, American dry per lb	.04¾	@	.05
" " in oil pure "	.05¼	@	.05¾
English, B. B. in oil	.08½	@	.08¾
Red, American "	.05½	@	.05¾
Litharge "	.05	@	.05¼
Venetian red, American "	.01	@	.01¼
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11½
Paris green "	.18	@	.19
Umber, Amer. raw and powdered per lb.	.01¼	@	.01½
Drop black, Amer. "	.08	@	.12
" " "	.09	@	.11½
Chrome green	.05	@	.15
Oxide zinc, American	.03¼	@	.04
" French	.06¼	@	.06¼

The two New Craters in Mt. Vesuvius from which lava has issued abundantly, were opened on the southern side at a height of about 200 metres above the upper station of the funicular railway. The lava flowed in the direction of Pompeii and Torre del Greco. The stream descends in a straight line for about half a kilometer, and then turning sideways, is directed towards the crater of 1872. The new craters present the appearance of a great cle . The lava has not spread beyond the side of the mountain.